

THE OPERATIONS OF SURGERY

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PART VI

OPERATIONS ON THE ABDOMEN

CHAPTER I

PREPARATION OF THE PATIENT FOR ABDOMINAL OPERATIONS

THE CHOICE OF INCISIONS AND SOME POINTS IN THE AFTER-TREATMENT

PREPARATION OF THE PATIENT

EXCEPT in emergencies it is advantageous to admit the patient into the hospital or nursing home a day or two before an abdominal operation. Not only is the rest valuable for the patient who also gets used to his attendants and surroundings generally but he can be *systematically examined* with the double object of ascertaining if he is a fit subject to undergo the operation and of making a more accurate diagnosis. For instance X-ray examinations of the stomach and intestine after an opaque meal has been given often reveal new and valuable facts.

The *preparations* which are necessary for all operations and have been already described in vol. 1 ch. 1 should be carefully carried out. Some special points in the preparation of patients for abdominal operations need further consideration here. After a hot bath the abdomen is generally shaved, washed with ether soap, dried and painted (but not rubbed) with 1 per cent. solution of picric acid in methylated spirit. This is done in the ward. There is no need to apply a compress or sterile pad. On the table the abdomen is again painted with picric solution. For all abdominal operations it is important to pay special attention to the diet and to get the bowels opened but not purged for this adds to the comfort of the patient during the first few days after the operation. As a rule no opening medicine is necessary if the bowels are acting naturally but otherwise a suitable and gentle aperient is given about thirty-six hours before the operation and if necessary is followed about twelve hours later by a saline draught. In some cases an enema is required and in certain conditions is the only necessary preparation of the bowels.

The patient should keep at rest on the day preceding the operation and before most abdominal operations it is best to give him simple plain

full diet up to the evening before : in cases of gastric disease and intestinal obstruction he should take only light but nourishing sterilised food, such as milk, eggs and fish, Benger's, soup, Bovril, bread and butter, coffee and tea with plenty of sugar or glucose. When the patient is unable to take or retain enough liquid by the mouth, enemata containing glucose (5 per cent.) are given to make up the deficiency. At least four pints of liquid should be given in one way or another during the twenty-four hours before the operation. Three hours before the operation half a pint of water containing half an ounce of glucose is given by the mouth or, failing this, by the rectum. Occasionally one or two pints of normal saline solution have to be run into the axillæ, and when anæmia is severe blood transfusion is adopted and has proved of great value. In some

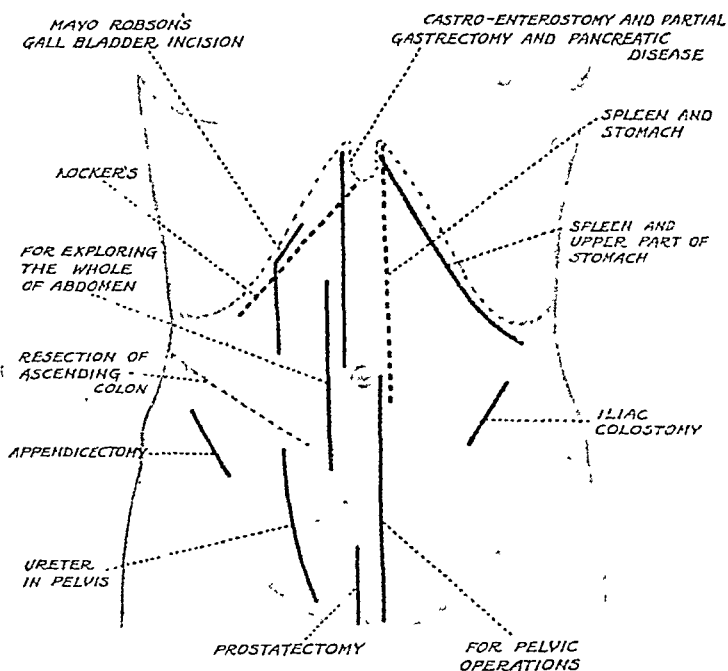


FIG. 1. Abdominal incisions.

cases it is an advantage to have the patient admitted three or more days before the operation. This is particularly so in cases of extreme pyloric obstruction requiring gastric lavage and saline enemata, cases of chronic intestinal obstruction requiring repeated doses of aperients and obscure urinary cases requiring careful investigation. It is also valuable when the mouth is septic and there are carious teeth or pyorrhœa alveolaris. The teeth may require scaling, some of them may have to be removed and others temporarily stopped. In any case a clean tooth-brush and mouth-wash should be used frequently during the day. These precautions are valuable in preventing pneumonia and parotiditis after the operation. Half an hour before the operation the patient is asked to empty the bladder, and if necessary a catheter is passed with the strictest aseptic precautions. A hypodermic injection of morphia and atropine (morphia gr. 1/6 and atrophine gr. 1/100 for an average adult) is usually given about

half an hour before the anæsthetic and is invaluable in allaying fear and in checking mucous secretion in the throat

It is especially important to do no abdominal operation if there is any evidence of catarrh of the throat or respiratory organs otherwise the risk of pulmonary complications is unusually great because of the interference with the use of the diaphragm and other respiratory muscles

The patient is warmly clad in a clean thick nightdress buttoning down the back wears long thick stockings and is covered with warm blankets

THE CHOICE OF ABDOMINAL INCISION

The ultimate result of an abdominal operation depends a good deal on the wise choice of the most suitable incision

The Site of the incision should be carefully chosen in order to give

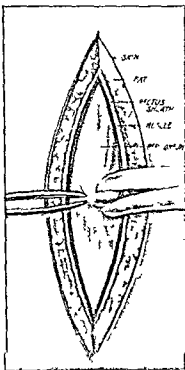


FIG. 2. Dividing the peritoneum which is held up with toothed forceps

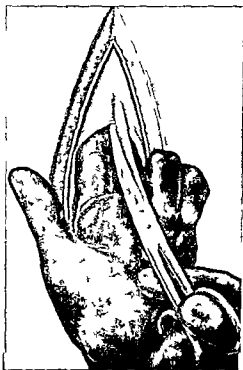


FIG. 3. Enlarging the peritoneal wound the fingers protecting the visera

the best approach with the minimum amount of damage. For instance when the appendix is known to be unusually high and retro-colic the ordinary McBurney incision does not give good access whereas a similar incision made somewhat higher and further back towards the loin is very satisfactory. In the same way when the appendix is believed to be in the pelvis the incision is made lower down and nearer the middle line with great advantage. In many cases a laparotomy must commence with a general exploration of the abdomen for in this way only can the cause of symptoms be thoroughly investigated by careful inspection and palpation. Under these circumstances the best place for the incision

is near the middle line, with its centre at the level of the umbilicus. Through an incision about five inches long in this position the whole abdomen can be thoroughly explored, and if necessary for treatment the incision can be enlarged either upwards or downwards without making an unnecessarily large wound.

The Size of the incision should be adequate without being excessive, for very large incisions undoubtedly weaken the abdominal wall; but it is a more common and worse mistake to make the incision too small. An inadequate incision makes the operation much more difficult and often leads to imperfect exploration, bruising and laceration of the edges with

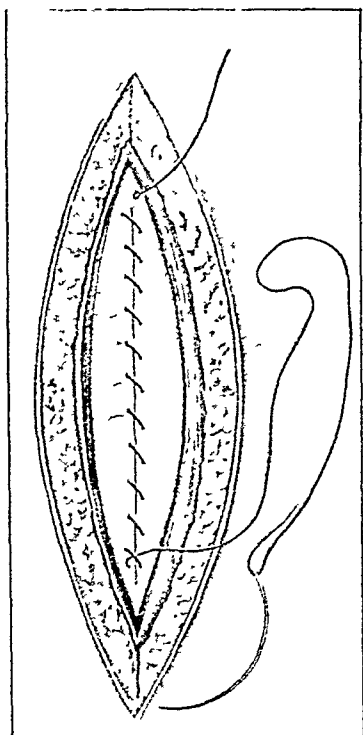


FIG. 4. The peritoneal suture of catgut has been commenced at the upper end of the wound.

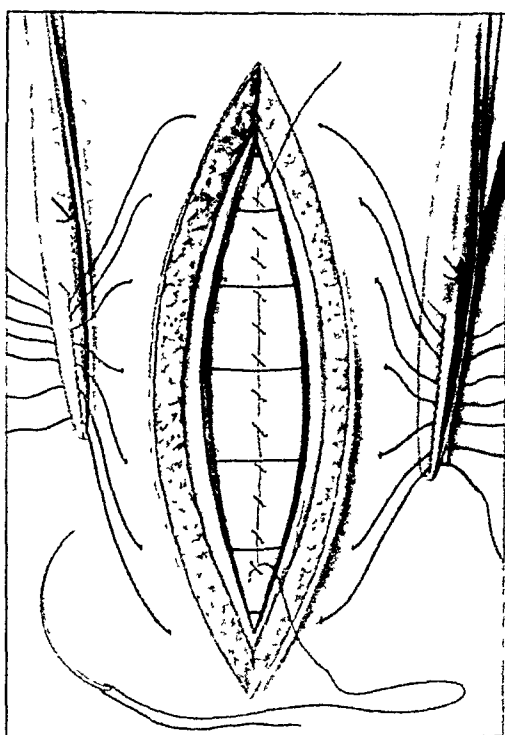


FIG. 5. Interrupted salmon-gut sutures have been inserted. Their ends are clamped while the catgut suture is continued up the anterior wall of the rectus sheath.

unsatisfactory closing and healing of the wound. Moreover, it is more difficult to cover and protect the edges of the wound from infection by septic abdominal contents which may be liberated during the operation. To improve the view, and especially to ease the sewing of the deep layers of the wound, it is essential to make the incision in the skin longer than the one in the aponeurosis. The incision in the transversalis fascia and peritoneum is still smaller. Fortunately the length of the skin incision on the abdomen is immaterial, and in very stout people it is an advantage to make the skin incision unusually long so that the fatty layers may fall aside, thus giving a much better access to the deeper parts. As far as possible the muscular fibres of the abdominal wall are not cut across, but merely separated or drawn aside. This is a valuable safeguard

against ventral hernia especially in the lower part of the abdomen. In the upper part the division of muscular fibres is not so detrimental, for instance the Kocher incision for gall bladder surgery or the transverse incision occasionally used for gastric surgery although it divides the fibres of the rectus muscle is very rarely followed by ventral hernia. Similarly the usual oblique incision in the loin for exposing the kidney is very rarely followed by hernia and as it also gives a much better view most operators prefer it to any form of muscular separation. For the same reason no nerve fibres are to be unnecessarily cut across. A long vertical incision through the outer part of the rectus or displacing it inwards may lead to

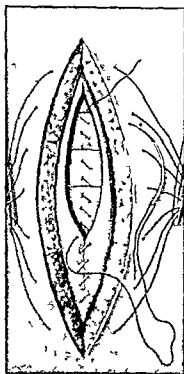


FIG. 1. The peritoneal catgut suture is continued up the rectus sheath.

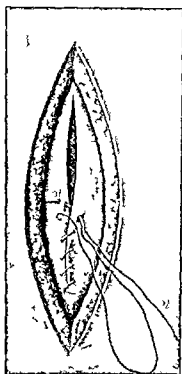


FIG. 2. The overlapping method of closing the rectus sheath.

paralysis of this muscle by division of its nerves and a troublesome form of ventral hernia follows. This is particularly liable to happen when the incision extends low down. It is far better to displace the rectus abdominis outwards, after incising the rectus sheath an inch from the middle line and reflecting it inwards. Similarly injury to the nerves lying between the flat muscles during the ordinary operation for appendicitis may lead to paralysis of the lower fibres of these muscles with the result that either a ventral or a right inguinal hernia may develop.

As far as possible the division or injury of the deep epigastric vein is also to be avoided especially when dealing with peritonitis or abscess for septic thrombosis of this vessel may then follow and extend to the iliac veins with disastrous results in the way of thrombosis or embolism.

The wound is made by a clean cut with a knife until the aponeurosis has been divided. Then the muscular fibres are displaced and held aside by smooth retractors. All bleeding is arrested with artery forceps and fine catgut ligatures. Then the transversalis fascia and peritoneum are picked up with toothed dissecting forceps and carefully divided either with blunt-pointed scissors or with a knife held sideways. First one and then two fingers are introduced to protect the bowel while the wound is enlarged with blunt-pointed scissors.

In many cases it is important to protect the edges of the wound from infection during the operation, and this can be done by accurately securing sterile pads round the edges with suitable forceps and self-retaining retractors directly the abdomen is opened.

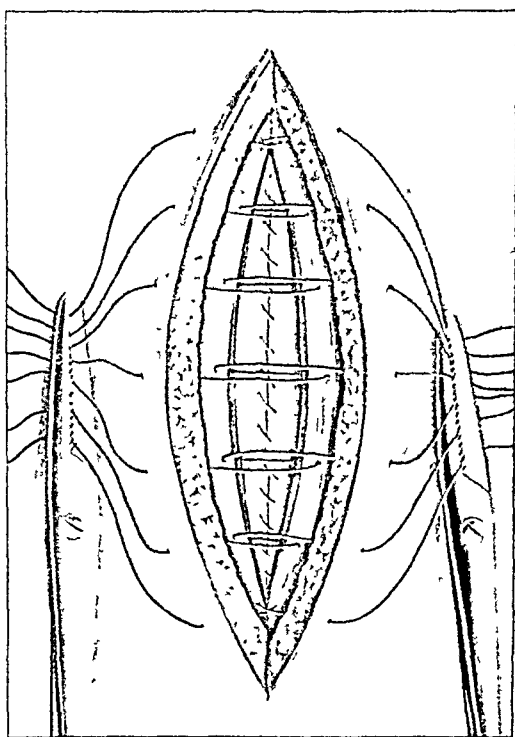


FIG. 8. Another and quick method of closing the abdomen in grave cases.

Closing the Wound Accurately. This is of great importance in order to prevent ventral hernia. While both ends of the peritoneal incision are held well up by an assistant with long toothed artery forceps, medium-sized catgut threaded on a curved round needle is used as a continuous suture to sew the peritoneum and deep layer of the rectus sheath, starting at the upper end of the incision. This is easier than working in the opposite direction. When the lower end is reached the needle is passed under the last turn of suture, which is then drawn tight. This prevents gaping of the lower end of the peritoneal wound with prolapse of the omentum during the next stage. Stout fishing-gut or linen thread supporting sutures are passed through the skin, subcutaneous tissues and the anterior layers of the rectus sheath. The ends of these sutures, which are about

three quarters of an inch apart are clamped together on each side of the wound and thus kept out of the way while the continuous catgut suture already mentioned is used to close the anterior wall of the rectus sheath from below up. It is tied to the long end left at the upper end of the peritoneal wound. The edges of the skin are brought together accurately with fine catgut. The supporting sutures are then tied. These are important for catgut is not sufficient by itself but may break when submitted to excessive strain during coughing or vomiting. This may lead either to a ventral hernia or even to the early prolapse of a loop of bowel into the deeper part of the wound where it may become obstructed or strangulated. To prevent this catastrophe silk or linen thread has been used for the buried suture but occasionally a stitch sinus follows. For this reason it is very much better to use strong catgut with supporting sutures to be left in about ten days. In some cases when the abdominal wall is lax and there is thought to be a risk of ventral hernia it is an advantage to overlap the aponeurosis after Noble's method.

When drainage has to be adopted a slit rubber tube of half to one inch internal diameter and containing a wick of thin folded rubber sheeting is used. The wick can be changed from day to day and the tube removed after several days without hurting the patient. A tube is far more efficient and less painful than gauze which adheres to the edges of the wound and often acts as a plug instead of a drain. The chief function of the tube is to keep open the passage in the abdominal wall, and there is no advantage in passing it deeply into the abdominal cavity where it may lie against the bowel or a blood vessel and cause infinite harm such as fecal fistula, hemorrhage or intestinal obstruction from direct pressure or the formation of bands later. The tube extends only just through the abdominal wall the rubber drain may safely pass deeper if not left in too long. The remainder of the wound is closed in layers in the usual way.

AFTER TREATMENT

Much of the increasing success of abdominal operations depends upon careful after treatment. It is a common mistake to interfere too much for it is sometimes difficult to know when to leave well alone but on the other hand treatment for some of the complications to be mentioned below has to be prompt to save life. Usually there is very little to be done beyond careful nursing and attention to the diet and general comfort of the patient. The difficulty lies in knowing quickly when things are going wrong. As far as possible complications should be prevented by care and untiring attention to detail before, during and after operation.

(1) *Posture* When returned to bed the patient has only one small pillow under his head and is rolled slightly to one side with another pillow behind the shoulders. This lessens the risk of the aspiration of vomit and enables the patient to breathe more freely as the tongue does not fall back. The nurse never leaves him until he has regained consciousness otherwise he may choke during vomiting. He is allowed peace and quiet to sleep off the effect of the anæsthetic. When he wakes up some hours later his head and shoulders are raised by several pillows. In this position he is much more comfortable and breathes more easily. Pulmonary complications are less likely and after gastro-enterostomy the contents of the stomach drain away more freely into the intestine. After operations

for appendicitis with suppuration the sitting-up or Fowler position tends to limit the infection to the pelvis : it also facilitates drainage soon after operations for peritonitis.

From the first the patient is encouraged to move his feet and legs in order to prevent wasting. Free use of the limbs and a change of position

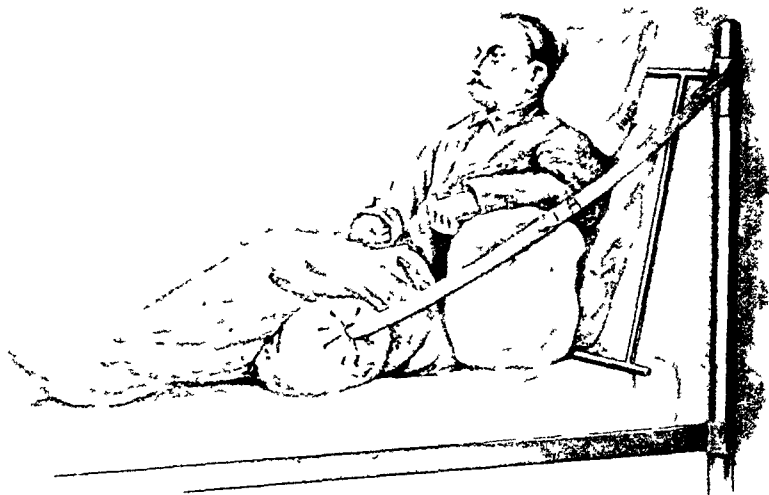


FIG. 9. The oblique or sitting-up position. The headpiece moves to any angle as it slips up and down the pillars at the head of the bed. The position is easily altered with the straps and buckles attached to the bolster under the thighs.

by the nurse at first and later by the patient also tend to prevent pain and weariness, and thrombosis with pulmonary embolism. Change of position and active movements are valuable also in preventing pulmonary complications. The patient is allowed the freedom of his bed, for it may

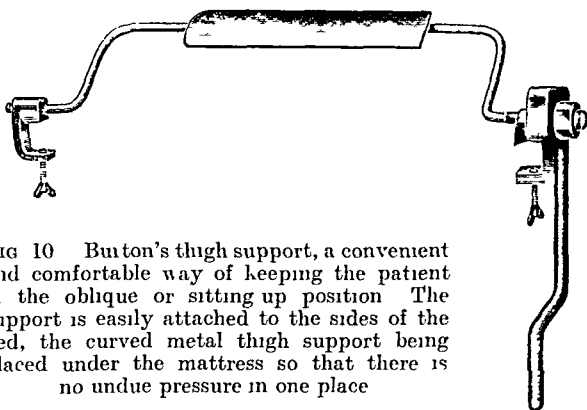
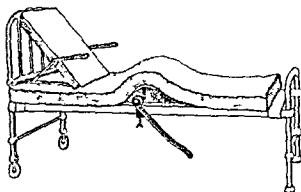


FIG. 10. Burton's thigh support, a convenient and comfortable way of keeping the patient in the oblique or sitting up position. The support is easily attached to the sides of the bed, the curved metal thigh support being placed under the mattress so that there is no undue pressure in one place.

be safely assumed that pain will prevent him from moving more than is good for him. For the same reason it is not good for the patient to be kept in bed too long. In most cases he can be lifted on to a couch at the end of three days and begin to stand and walk with the help of the nurse

on the fourth or fifth day. I believe that stagnation in bed is one common cause of thrombosis pulmonary embolism and pulmonary complications generally. After many operations the patient can safely leave the hospital or nursing home for a convalescent home at the end of ten days or a fortnight but it is rarely wise for him to return to work under three or four weeks from the date of the operation. A too early return leads to an incomplete recovery of general health. After operations for gastric or duodenal ulcer a much longer rest and the most careful dieting are imperative.

(2) **Shock** To lessen shock the head is depressed the abdomen is firmly supported by a many tailed Landage and sometimes by a large towel in addition and the patient is kept warm with blankets and hot water bottles. Directly after most major abdominal operations a pint of saline glucose solution is given by the rectum. At this time it is generally retained and rapidly absorbed with great advantage. To lessen pain, discomfort and vomiting 30 grams each of aspirin and sodium bromide may



11. Betonsstift

be added. In many cases half a pint of the solution is given every four or six hours for one or two days. In some cases an infusion of about one pint of warm normal saline solution (temp. 105° F) or 3 per cent solution of dextrose is given into the middle of each axilla immediately after the patient is returned to bed and pituitary extract is injected either intramuscularly or directly into a vein. In a few cases of great urgency when the circulation is too poor to absorb the saline solution from the nripit a pint of Baylies' gum arabic solution is given directly into a vein, usually the median basilic and the injection may be repeated after two hours if necessary. When there is severe anæmia transfusion of blood is adopted as soon as a suitable donor can be secured and is most valuable (see vol. 1). Half a pint of saline or glucose solution is given by the rectum every six hours until vomiting has ceased and the patient is taking enough liquid by the mouth. Sometimes warm saline solution is continuously and slowly administered by the rectum. The rectal tube should have several apertures and should not be too long or have too small a lumen otherwise flatus cannot escape with the result that the saline is not

retained. This is especially valuable in cases of peritonitis, when as many as five or six pints are often given in twelve hours. There is no advantage in giving more. In most cases these enemata are not required after twenty-four or thirty-six hours. They lessen thirst, shock and vomiting.

(3) **Thirst.** This is also alleviated by making the patient wash out his mouth with water or a weak solution of bicarbonate of soda, and especially by the frequent cleansing of the mouth by the nurse with lemon-juice and glycerine or glycerine and borax. There is rarely any harm in allowing the patient to slake his thirst by drinking water freely, and this often checks vomiting. The teeth are thoroughly cleaned at least twice a day with a clean tooth-brush and an antiseptic solution such as Listerine. The tongue is also thoroughly cleaned with lint moistened with glycerine and borax. These precautions, besides adding to the patient's comfort, greatly diminish the risk of pulmonary complications from the aspiration of septic material into the lungs. They also make ascending septic infection of the parotid gland very rare at the present day.

(4) **Vomiting.** For various reasons vomiting after operations is not nearly so common or severe as it used to be a few years ago. More perfect asepsis; the better administration of anæsthetics, especially the almost universal adoption of open ether following morphia and atropine, which lessen the amount of anæsthetic used; and the more common use of saline infusion in one way or another, all lessen the severity of vomiting. Keeping the patient's head low and turned to one side during the administration of the anæsthetic in order to prevent swallowing of mucus saturated with the anæsthetic also helps to prevent vomiting from the direct irritation of the stomach by the anæsthetic. It is often a good plan to let the patient take a good drink of warm solution of bicarbonate of soda to wash out the stomach. Repeated doses of about 30 grains of sodium bicarbonate are also valuable, for the vomiting is often due to acidosis. Chlorotone, 10 grains given by the rectum, often acts like a charm and is especially valuable as a preventative when given immediately after the operation. When the vomiting continues after twenty-four hours other causes than the anæsthetic must be considered. In many cases it is due to partial paralysis and over-distension of the stomach. In any case lavage should be tried, the stomach being thoroughly washed out with a weak solution of bicarbonate of soda. If this does not stop the vomiting there is usually a more serious cause, such as peritonitis or intestinal obstruction. In these conditions the contents of the intestine regurgitate into the stomach and vomiting continues. Occasionally it continues for several days after the operation, apparently without any adequate cause. These patients are mostly very nervous women. In addition to washing out the stomach warm applications or even a blister may be applied to the epigastrium, and a dose of sodium bromide 30 grains, and chloral hydrate 25 grains, may be given by the rectum. In some cases the vomiting may be due to acute dilatation of the stomach or duodenal ileus, and the possibility of these is always to be remembered. At first there is bulging of the epigastrium, and later on the whole abdomen becomes enormously distended. Small quantities are brought up at frequent intervals. The stomach tube should be passed at once and the stomach thoroughly emptied and washed out, and the position of the patient should be changed as suggested by Moynihan, who recommends the prone position with

elevation of the pelvis. This complication is fortunately a rare one and can I believe be prevented by resorting to lavage early enough. X ray examination after an opaque meal may reveal duodenal ileus for which an anastomosis between the distended third part of the duodenum and the jejunum some six inches from its origin has proved effective, as shown by Codman¹ Devine and Willie².

(5) **Food** When nausea has ceased water is given by the mouth at first in small quantities but if it does not cause vomiting it is rapidly increased. After twelve to twenty four hours equal parts of milk and water or barley water are given in small feeds such as one to two ounces every hour. In many cases weak tea is also given early and is often liked and retained when milk is not. After twenty four hours milk thickened and flavoured in different ways, soup or beef tea, and jelly are given also lemonade or orange or grape juice. On the third day thin bread and butter milk puddings and lightly boiled eggs are given and on the fourth or fifth day more solid food in the form of fish sweetbread or chicken is given. As a rule except after gastric operations for simple ulcer the sooner the patient returns to full diet the better. All milk and food given in the early days after the operation should be sterilised. Occasionally vomiting and diarrhoea prevent the absorption of anything administered by the mouth or rectum. Saline infusions into the axillæ or thighs given slowly and continuously or intermittently usually suffice. In some cases sterilised olive oil or normal horse serum is given subcutaneously.

(6) **Pain** For the relief of pain aspirin 10 grains by the mouth or 20 to 30 grains by the rectum usually suffices. In some cases however when the pain is severe or the patient feeble and exhausted from want of sleep a small dose such as $\frac{1}{2}$ or $\frac{1}{4}$ grain of heroin or morphine may be given in the evening. It is rarely wise to repeat the dose for morphine paralyses unstriated muscle increases flatulence and tends to produce paralytic distension of the bowel.

(7) **Urine** As a rule very little urine is secreted during the first twelve hours after an abdominal operation. The patient should be encouraged to empty the bladder at the end of twelve hours and regularly every four hours after this. In this way paralytic distension of the bladder can be avoided. If there is any difficulty it is an advantage to turn the patient on his side and to apply hot fomentations or give an enema. If there has been no relief within twenty four hours a boiled soft rubber catheter is passed with due aseptic precautions. Afterwards the patient should be encouraged to empty the bladder every four hours in order to avoid a repetition of the trouble. If necessary the catheter is passed every eight hours until the power of the bladder has returned. In some cases retention of urine is overlooked because the patient passes water in small quantities at short intervals. This means paralytic distension with overflow, and when a catheter is passed a large amount of urine may be found in the bladder. This condition may not develop until several days after the operation. For this reason it is of great importance to measure the urine for the first few days. The patient generally passes about one pint in the first twenty four hours and afterwards should pass at least two pints every twenty four hours.

¹ E. A. Codman *Boston Med. & Surg. Journ.* 1908 clvi: 503

² D. P. Willie *Brit. Journ. Surg.* 1901 ix: 24

(8) **Flatulence.** If there is much flatulence, this, when chiefly gastric, is often relieved by propping the patient well up and by occasionally giving a drop of peppermint oil on a small piece of bread by the mouth and immediately washing it down with water. Intestinal flatulence is often relieved by passing a rectal tube into the lower part of the rectum and leaving it there for some time. In extreme cases a turpentine enema (oil of turpentine 1 oz., mucilage of starch 15 oz.) is used and rarely fails to afford relief. Pituitary extract given subcutaneously often acts like a charm.

(9) **Purgatives.** Usually the rectum is washed out with a pint of soap and water every morning and about an ounce of liquid paraffin is given once or twice a day, beginning on the second day. It is rarely necessary or wise to give any other aperient by the mouth until the evening of the third day, when pil. col. et hyos., gr. 4 to gr. 8, may be given, followed by a saline draught in the morning, and if necessary by an enema. In some cases 1 oz. of castor oil is given early in the morning, and followed by saline and an enema if necessary. This has the advantage of allowing the patient a comfortable night. Afterwards some mild aperient, such as infusion of senna pods or liquid paraffin, is given if required. In many cases, especially acute abdominal conditions such as appendicitis with suppuration, or where peritonitis from whatever cause is feared, it is better not to give any aperient by the mouth within the first four days. It is not wise to increase peristalsis in these cases, for movements of the bowel tend to disseminate infective material. Generally the bowels act spontaneously on the third or fourth day, especially when the lower bowel is kept empty by the daily wash-out. The bowels are generally almost empty at the time of the operation, and there is no advantage to be derived from giving purgatives in the first few days. In cases of peritonitis not only are purgatives often ineffective, but they also add greatly to the patient's discomfort, act as irritant poisons, and tend to increase paralytic distension. It is only an ancient superstition that recovery from peritonitis depends on free purgation. Calomel, even in small doses given repeatedly, is especially dangerous when it fails to act.

(10) **Dressing the Wound.** When the wound has been completely closed it is rarely necessary to disturb it for about ten days, although a tight bandage may need to be readjusted and excess of dressings may need removing. When the wound has been drained the tube is not disturbed for at least thirty-six hours, when it is removed if the discharge is slight and inoffensive. When there is free discharge of pus, as there often is from a subacute abscess due to appendicitis, it is wise to leave the tube in for two, three or four days in order to prevent a re-collection of pus, but the tubes should never be long enough to press on the bowel and thus cause a fæcal fistula. Syringing is unnecessary, painful and dangerous.

Complications. Most of these have already been mentioned, but it is well to consider some of them more fully.

(a) *Hæmatemesis.* This sometimes follows gastric operations when the sewing is at fault. Apart from this the vomit may be black from altered blood, in late cases of intestinal obstruction. This is a very grave sign and usually indicates acute blood changes with oozing from

the mucous membrane of the stomach and upper intestines. The best thing to do is to wash out the stomach if the condition of the patient allows this. rest, blood transfusion and saline infusions into the axillæ or rectum are also valuable.

(b) *Peritonitis* That this is a very rare complication at the present day is chiefly due to the careful precautions taken during operations to prevent leakage or contamination. We owe much to the careful and routine use of clamps and packs. The adoption of continuous sutures instead of mechanical devices such as Murphy's button for making anastomosis is also a great safeguard against sloughing and secondary leakage which used to be more common. The universal adoption of rubber gloves has done a great deal to exclude extraneous infection. Occasionally however peritonitis does develop after an anastomosis of the lower part of the intestine for intestinal obstruction. It is of very great importance to recognise the condition for it is well known that a secondary peritonitis is easily overlooked and has a very high mortality. It is rarely worth while to open the abdomen when the disease is well advanced but if the condition is recognised quite early reopening the abdomen and adequate treatment of the cause with free drainage of the peritoneum are always worth doing. The early signs of peritonitis are therefore of great importance. These are pain and restlessness with an increasing pulse rate from 110 to 140. The pulse always becomes weak and the patient soon cold and clammy with an anxious expression. The knees are drawn up sometimes there is vomiting or hiccough sometimes the temperature goes up but above all the abdomen becomes tender fixed and rigid. These signs are especially ominous when they present themselves in the flank where they cannot be mistaken for the natural tenderness around the wound.

(c) *Intestinal obstruction* sometimes follows abdominal operations but is not always due to them. It is especially likely to happen from kinking after incomplete operations for suppurative appendicitis. Occasionally a kink or band forms above an anastomosis or accidental hernia either into the deeper part of the wound or into the omentum or mesentery may occur. It is of vital importance to recognise the condition while it is still hopeful. The most important sign is persistent vomiting in spite of lavage the vomit gradually becoming bilious and later brown and foul. Meanwhile the pulse is slow and the patient in much pain and collapsed. The bowels fail to act in spite of repeated enemata. The excretion of urine is almost abolished and abdominal distension increases with visible peristalsis in some cases. When the condition is strongly suspected the abdomen should be opened without delay and the condition dealt with as may seem fit.

(d) *Pulmonary complications* Attention has already been drawn to the great importance of keeping the mouth clean and of the sitting up position. Care should also be taken to prevent infection from the anæsthetic apparatus or from the aspiration of vomit during or after the anæsthetic. For this reason it is of the greatest importance to wash out the stomach before the operation in many cases of intestinal obstruction and also of gastric dilatation. The abdominal bandage should not be tight enough or extend high enough to restrict breathing and the patient should be encouraged from the beginning to take deep breaths several times daily.

Compression of the bases of the lungs should also be avoided during the operation. For this reason the Trendelenburg position, when required, should not be maintained longer than necessary.

The anæsthetic, especially ether, has been held responsible for pulmonary complications following operations, and there is no doubt that the chilling effect of ether on the lungs of old people, especially those already subject to chronic bronchitis, is detrimental, and for them either equal parts of chloroform and ether or chloroform is to be preferred. It is very important to avoid undue exposure of the patient before, during and after operation. He should be warmly clothed and shielded from draughts, especially when collapsed after the operation. With the same object in view the theatre should not be too hot, so that the contrast may not be too great. Too frequently the patient, drenched with perspiration in a hot theatre, is carried to a comparatively cold ward. I firmly believe that it is rarely advantageous to have the temperature of the theatre above 65°, for not only does the free perspiration commonly seen predispose to chills, but it also increases shock by depletion.

The most common pulmonary complications are pneumonia, especially of the lobular type, bronchitis, pleurisy, and empyema. They are particularly apt to follow operations on the upper abdomen which more commonly limit the movements of the diaphragm. They are undoubtedly due to septic embolism in a great many cases, and this is an additional reason for providing efficient drainage in septic cases and for removing a diseased appendix and its blood-vessels in cases of suppurating appendicitis.

A post-operative empyema is particularly likely to be overlooked; an exploring needle should be inserted when there is reasonable suspicion of its existence.

(e) *Thrombosis and Embolism* are mostly due to stasis and sepsis of the blood. Too complete rest in bed lowers the force and frequency of the heart-beat, retards the circulation, and predisposes to clotting. For this reason the patient should be turned and moved about fairly freely from the beginning and should be encouraged to move his limbs freely. For the same reason it is important to get the patient out of bed after an operation as soon as possible. It is also an advantage in many cases, especially when the pulse is weak and slow, to give small doses of strychnine. It is said that a too exclusive milk diet predisposes to clotting on account of the large amount of lime salt. There is no doubt, however, that the clot contains bacteria, often of low virulence, in nearly all cases, so that phlebitis frequently precedes or accompanies thrombosis. For this reason it is of great importance to aim at perfect asepsis throughout abdominal operations and also to avoid injury to veins, especially in dealing with septic conditions. For the same reason it is important to open abscesses early and to drain them thoroughly without allowing the tube to press upon the veins. It is especially noteworthy that thrombosis is particularly liable to follow pelvic operations, especially hysterectomy. In these cases it is probable that a mild septic inflammation short of suppuration prevails in the tissues of the pelvis and causes inflammation of the iliac veins. As is well known, the left leg is the one most commonly affected. For various reasons the venous return from this leg is poorer

than from the right. When signs of thrombosis develop it is important to keep the patient at rest for at least three weeks so as to avoid as far as possible the risk of embolism.

Pulmonary Embolism as a rule is an unforeseen catastrophe, for in the majority of cases there has been no indication of a previous thrombosis, although organised clot taken from the pulmonary artery and floated in water sometimes shows by its shape that it has previously occupied a large vein and its tributaries. Usually this is the internal iliac vein, an examination of which after death may show adherent clot or signs of phlebitis. In other cases the clot is formed in the right auricular appendix. In most cases the embolus is not large enough to block the pulmonary artery so completely as to cause sudden death, but spreading thrombosis may gradually complete the obstruction. In many cases smaller emboli block some of the larger or smaller branches of the pulmonary artery. Infarction follows and is indicated by pain, dullness, a rub, and hæmoptysis. In grave cases nothing does any good, but the administration of oxygen and strychnine should always be tried and may tide the patient over his difficulties in some cases of incomplete obstruction. In a few the embolus has been removed from the pulmonary artery but not as yet with any permanent success. The best known way to prevent pulmonary embolism is to adopt the precautions against thrombosis which have been already mentioned.

CHAPTER II

OPERATIONS ON HERNIA

OPERATIONS FOR STRANGULATED HERNIA RADICAL CURE OF HERNIA

OPERATIONS FOR STRANGULATED HERNIA

It is very important to operate early and not to waste valuable time on taxis. Thus Carwardine¹ from an analysis of 183 cases found the mortality to be less than 2 per cent. in those operated upon within twelve hours, more than 10 per cent. when twelve to twenty-four hours had elapsed before operation, and that after five days had been wasted 60 per cent. died.

Chief Indications for Operation and Points to bear in mind. While this is not the place for going into the above fully, a few practical remarks on those indications usually given may be helpful to some of my readers:

A. *Local.* A lump at one of the openings, more or less hard, tense, tender, dull, partly or completely irreducible, and with impulse doubtful or absent. A hydrocele appearing with or soon after the onset of intestinal obstruction is probably a hydrocele of a hernial sac with strangulation. The following case is an interesting example :—

CASE 1. *Strangulated Hernia. Laparotomy.*—A young man, aged 25, was admitted into Guy's Hospital on March 16th, 1910, suffering from intestinal obstruction, with the following history. Ten days before he was seized with violent abdominal pain and vomiting. Since then his bowels have not been opened and he has been sick on and off ever since, and has suffered severely from griping pains in the abdomen. He has never had a similar attack before. He has never noticed a rupture and has not had an attack of appendicitis. Upon admission the patient looked very ill and terribly shrunk about the face; his skin was dry and shrivelled. His lips were dry and he could only speak in a whisper. The abdomen was uniformly but not greatly distended; the flanks were neither distended nor full posteriorly. A coil of intestine could be seen occasionally lying across the upper part of the abdomen. There was a moderate sized hydrocele on the right side, which the patient said had appeared since the onset of his illness. The cord was a little thicker than normal, but no hernia could be discovered. The patient was infused, taking one and a half pints subcutaneously. He improved very much after this and an operation was performed, the abdomen being opened near the middle line and the right rectus displaced outwards. Several coils of distended intestine were at once seen. There was some free fluid in the peritoneal cavity. On passing a finger down into the right iliac fossa a band of omentum was found, extending into the internal abdominal ring, and also a loop of intestine. Clearly the condition was one of strangulated hernia. The omentum was tied and divided. The internal ring was gradually dilated by means of the finger and, with gentle traction, the loop of bowel was withdrawn into the abdomen; it was about two and a half inches long. All the calibre of the bowel was involved, so that the obstruction was complete. The bowel was not gangrenous and its circulation soon returned after it had been released. There was no greyish-white depression at the site of the strangulation. An attempt was made to draw the sac upwards into the abdomen, but this having failed an incision was

¹ *Brit. Med. Journ.*, 1901, ii, 573.

made over the inguinal region and the sac was exposed and opened. It was found to extend into the tunica vaginalis. It was rapidly separated from the structures of the cord and testis, a radical cure performed and the abdomen closed. The patient made a good recovery.

(a) The swelling may be small and deep seated, as in a bubonocoele near the internal ring, a femoral hernia in a fat patient or an obturator hernia. All the hernial apertures must be carefully examined before the abdomen is opened for intestinal obstruction. Example —

CASE 2 *Strangulated Femoral Hernia mistaken for Intestinal Obstruction. Operation under Local Anaesthesia. Recovery.*—Mr C., aged 84 had had a prostatectomy done nearly three years before and had nearly died afterwards. He took the anaesthetic badly and the wound was a very long time healing. There was much cystitis. In July, 1913 he had phimosis with balanitis and had a circumcision, he nearly died under the anaesthetic. On August 14th, 1913, he was feeling well, went to London and enjoyed himself thoroughly. He had a big dinner and ate a lot of fruit at his club. That evening he was very sick and had much pain during the night. The sickness and pain continued on the 15th, but he was a little better on the 16th. His abdomen was very distended and peristalsis could be seen. He became weaker and I saw him at 6 p.m. on the 17th with his usual medical attendants. A diagnosis of growth of the bowel had been made, but nothing could be felt from the rectum. The vomit was frequent and fecal when I arrived and the patient was feeble. There was a hernia at the site of the prostatectomy and the doctor had examined this carefully without finding anything abnormal. Just below it however there was a small hard lump in the right femoral region. I advised an operation under local anaesthesia. The patient's relations absolutely refused to have another general anaesthetic given, preferring to let him die rather than run the risk of it. Therefore the operation was performed under novocaine and adrenalin. There was a small knuckle of small intestine in the sac with some sanious fluid. The bowel was reduced and the sac was tied and excised. The wound was sewn up. The patient suffered very little pain but complained of thirst when I was dividing the neck of the sac. Otherwise he was comfortable. He fell asleep before the end of the operation. He had not slept at all since the 13th. He made a good recovery and would not believe he had had an operation when it was mentioned some days later.

(b) Two herniae may be present both irreducible. The surgeon should operate on the one which is the more tense and has the less impulse, and the one which has the more recently descended. If this fail to reveal the obstruction either the opposite swelling must be explored or abdominal section performed in the middle line. This step will probably allow of the opposite hernia being reduced from within and also of any other possible seats of strangulation being explored viz the inner aspects of the deeper rings.

(c) As to the impulse it is worth while to observe carefully the point where this ceases. This probably is over the site of stricture, and should be about the centre of the incision.

Sir W. H. Bennett pointed out that "every case of hernia in which any change has taken place in the condition of the tumour such as increase of size or tension whilst expansile impulse is absent, should be regarded as strangulated."

(d) Sir J. Paget¹ thus wrote of the hardness of a hernia: "In large herniae the hardness may chiefly be felt at and near the neck and mouth of the sac, especially in inguinal hernia, and you must take care not to be deceived by a sac which is soft and flaccid everywhere except at its mouth for there may be strangulated intestine in the mouth of the sac, though the rest contain only soft omentum or fluid not sufficient to distend it, nay, you must not let even a wholly soft condition of the

¹ *Clin. Lectures and Essays*, p. 104.

hernia, or an open external ring, weigh down against the well-marked symptoms of strangulation, for the piece of intestine at the mouth of the sac may be too small to give a sensation of hardness, or the whole hernia may be omental."

B. General. *The Symptoms of Intestinal Obstruction.* (1) Constipation becoming absolute, even as to flatus. It is well known that small scybalous motions may be forced out by the straining of a patient with a strangulated hernia anxious to get his bowels to act. Further, and in intestinal obstruction generally, the bubbling away of an enema may simulate the passage of flatus. In those rare cases where, other evidence of strangulation being present, the bowels continue to act at intervals, it is probable that the constriction of the bowel is not complete, but leaves a channel along the mesenteric border (Richter's partial enterocoele). In such cases which have been left long, owing to the absence of constipation and perhaps the slightness of the vomiting, the surgeon must examine the bowel very carefully before he returns it. Constriction, though only partial, may have caused here, from its long duration, thinning or ulceration of the intestine at one spot, and fæcal extravasation may take place soon after the bowel is returned.

Constipation may be absent in cases of strangulation of the omentum alone, or of an appendix epiploica, or of the ovary.

(2) Vomiting.¹ Especially if (a) this is changing from the early rejection of stomach contents or bile to fæculent fluid; (b) even if it is repeated only at long intervals, and all other signs are absent or little marked; (c) it must be remembered that vomiting may be stopped by drugs, strangulation persisting, or the intestines may be empty. There is often a deceptive lull in this symptom after two or three days, the vomiting recommencing again later.

(3) Shock more or less severe, according to the suddenness of the onset and the severity of the strangulation.

(4) Colicky pains occurring at short intervals, usually terminating in vomiting. These pains are usually referred to the umbilical region, and are due to the powerful but futile peristalsis of the obstructed small intestine. They are very characteristic of intestinal obstruction. Coils of small intestine with visible peristalsis may be noticed.

(5) The sunken, sallow features and anxious countenance, and the scanty high-coloured urine from intestinal obstruction.

(6) Tympanites and abdominal tenderness.

These will not, of course, debar the surgeon from operating, but they will lead him to warn the friends that relief will possibly come too late.

STRANGULATED FEMORAL HERNIA

The stomach may be washed out in some cases just before the operation to minimise the dangers incident to the vomiting of foul material during the operation and afterwards.

Operation. While general anaesthesia will be preferred in most cases from the more certain loss of sensibility and the relaxation of the parts,

¹ Sir J. Paget (*loc. supra cit.*, p. 113) says: "If I were asked which of the signs of strangulation I would most rely on as commanding the operation, I should certainly say the vomiting." Later on he urges that the practitioner should not wait for any characteristic mode of vomiting, nor be misled by the absence of any particular fluid, nor even by the absence of all vomiting, nor underestimating the importance of occasional vomiting as a signal for operation.

local or spinal anæsthesia may be used with very great advantage when a general anæsthetic is contraindicated especially by bronchitis or toxæmia from delay. An incision three or four inches long is made obliquely over the swelling its outer end being an inch above the middle of Poupart's ligament and the inner extending over the inner and lower end of the hernial sac. Poupart's ligament and the lower fibres of the external oblique are defined. The cribriform fascia and the fascia propria (femoral sheath and septum crurale) are next divided in the same line with or without a director¹ according to their thickness and the experience of the operator all the incisions made going quite up to and above the top of the swelling so as to lie over the seat of strangulation at the neck of the sac.

The varieties here are best given in Sir James Paget's words. In some instances as you trace up the neck of the sac you find it tightly banded

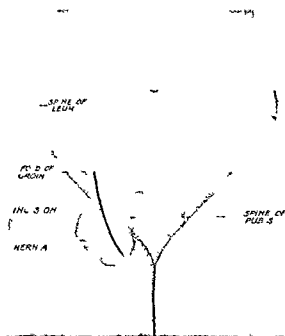


FIG. 19. Site of incision for strangulated femoral hernia.

across by a layer of fibrous tissue called Hey's ligament, a layer traceable as a falciform edge of the fascia lata where that fascia bounding the upper part of the saphenous opening is connected with the crural arch and is thence continued to Gimbernat's ligament. Sometimes a fair division of this layer of fibres up to the edge of the crural arch is sufficient to render the hernia reducible. But in many cases this is not sufficient and you may feel the stricture formed by bands of fibres which encircle the neck of the sac and which must be divided band by band and layer by layer till none can be felt. These fibres are part of the deep crural arch. Very rarely however even the division of these is not sufficient for the stricture is formed by thickening of the mouth of the sac itself. This condition which is a common cause of stricture in

The operator can also manage very well with a scissor as he keeps the point of the scissor just over a little separated from the external iliac vessels.

inguinal hernia, is very rare in femoral; but it certainly does occur." In trying to divide points of stricture outside the sac attention should be paid to the following: (1) Always opening the inguinal canal and thus exposing the very neck of the sac thoroughly; (2) carefully drawing down the sac, so as to expose any fibres constricting its neck; (3) gently insinuating the point of the director under any bands met with.

Opening the Sac. The sac must always be opened, because (1) of the great importance of examining the bowel; (2) the dangers of opening the sac are negligible, whereas the dangers of reducing the hernia without opening the sac are great; (3) it renders an attempt at radical cure possible, and this should be done in all patients who are not *in extremis*.

Much difficulty is occasionally met with in identifying the sac. The causes of difficulty here are mainly: (1) an altered condition of the soft parts from the pressure of a truss, or from long strangulation; (2) from meeting with fluid outside the sac; (3) from the extreme thinness of the patient, which leads to the sac being reached unexpectedly; (4) from the opposite condition, much fat being met with in several of the deep layers, making it uncertain which is the extra-peritoneal layer, the fat in these cases being often soft and readily breaking down under examination; (5) an apparently puzzling number of layers—this condition is usually due to "hair-splitting" over-carefulness on the part of the operator, at other times it is brought about by a much thickened fascia propria separated into imperfect layers by its softened condition in inflammatory matting; (6) by the absence of a sac.¹

Aids in Recognising the Sac in Cases of Difficulty. Several of those ordinarily given²—*e.g.*, "its rounded and tense appearance, its filamentous character, and the arborescent appearance of vessels on its surface"—are, I think, quite fallacious. So, too, with regard to the escape of fluid from the sac, for this is often dry in femoral hernia, and occasionally fluid is met with before the sac is reached. A smooth lining characteristic of its inner surface is more reliable, but the inner surface of the fascia propria is sometimes remarkably smooth. The hernial sac is denser than any of its coverings, and is of a bluish-white colour. It may be so thin that fluid and bowel may be seen within it; it can often be pinched up and moved upon its contents. Moreover, the omentum differs from the extra-peritoneal fat in having much larger and characteristic veins. Two points remain which will help to solve the doubt: (a) To draw gently down the doubtful structure, whether sac or bowel, and to examine whether it is continuous above and below with the structures of the abdomen and thigh, like the other coverings of the hernia, or whether it has a distinct neck to be traced into the abdominal cavity. (b) To see if the point of a director can be insinuated along this last doubtful layer into, and moved within, the peritoneal cavity or no. In a very few cases the surgeon, if still in doubt, incises carefully the suspected layer, and tries to pass in a probe and move it from side to side; if this can be done, he is still outside the bowel, not between the peritoneal and muscular coats of intestine. The difficulties here are, however, so great that several operators have reduced a femoral hernia *en masse* during the operation of

¹ A sac is absent in some cases of hernia of the cæcum, and where the patient has been operated on before.

² Erichsen.

herniotomy, and others have only prevented this catastrophe by great care. The fascia propria has been mistaken for the sac, and the subperitoneal fat for the omentum—this has been reduced into the extra peritoneal tissues just above the femoral ring the bowel remaining strangulated in the displaced sac. To avoid this catastrophe it is always wise to pass a blunt dissector well into the abdomen. There is no difficulty in doing this if the sac has been opened.¹

The sac, being carefully nicked with the scalpel blade held horizontally at a spot where it can best be pinched up with dissecting forceps—a matter of much difficulty at times, owing to its tenseness—is slit up on a director, and its contents examined. The escaping liquid, which may be septic, is carefully mopped away. If omentum first present itself, this is drawn to one side and unravelled and intestine sought for. This usually takes the form of a small, very tense knuckle, of varying colour and condition. If it will facilitate the manipulations needful for reduction, the omentum may be first dealt with. (1) If this be voluminous and altered in structure, it should be tied, bit by bit with strong catgut, and then cut away. For security's sake the ligatures should be made to interlock. After the return of the intestine the omental stump is also replaced within the abdomen. (2) If the omentum be small in amount and recently descended it may be merely returned.

Reduction of the Intestine. As soon as this is exposed the surgeon examines with the little finger, or a Key's director, the tightness of Gimbernat's ligament. In a few cases reduction may be at once effected by gentle pressure backwards on the bowel with the tip of the little finger. But in the large majority the stricture will need division—a point requiring much carefulness for fear of injuring the intestine or important surrounding structures. If the degree of tightness of the parts admit of it, there is no director so safe and satisfactory as the index or little finger of the left hand passed up to the stricture, the hernia knife being introduced along the pulp of the finger. But there is rarely room for this, and a Key's director² must usually take the place of the finger. The tip of this instrument being insinuated into the peritoneal cavity just under Gimbernat's ligament, the hernia knife³ is introduced obliquely or flat wise upon it, its end slipped under and beyond the ligament, its edge turned towards the constricting fibres and a few of these gently cut through in an upward and inward direction. In doing this it is well for the surgeon to draw down the edges of the cut sac close to its neck and to ask an assistant to hold these, thus facilitating the passage of the director and the knife by preventing the sac falling into folds before them. Occasionally, also, a knuckle of intestine persistently coils over the edge of the director. This is best met by patience, by drawing it out of the way by the fingertip of an assistant, or by pressing it down with the handle of a pair of dissecting forceps.

¹ See Rowlands, *Reduction en Masse*, *Guy's Hosp. Reports* 1902, lvi 131.

² This director is broad, so as to prevent any intestine curling over and reaching the knife, blunt pointed, so as not to damage the contents of the peritoneal cavity, finally, its groove does not run quite up to the end so that the knife point shall be stopped before it comes in contact with the important parts.

³ A curved one will be found most useful. The cutting blade is usually too broad and the tip too massive. On the other hand, a worn-down blade has been known to break while dividing a tense Gimbernat's ligament. The intestine may thus be wounded, or the fragment of the knife escape into the peritoneal cavity.

The direction and the extent to which the stricture must be cut are matters of much importance. The forward and inward line is the only path of safety. Directly outwards lies the femoral vein; by cutting upwards, the spermatic cord, and, if upwards and outwards, the epigastric artery, would be endangered; behind are the peritoneum and pubes. The incision forwards and inwards must be of the nature of a nick; otherwise, owing to the imperfect healing of the fibrous structure, the ring will be left large and gaping, thus facilitating the re-descent of the hernia, producing much difficulty in fitting trusses, and causing certain discomfort and probable peril to the patient, especially if she belong to the poorer, hospital class.

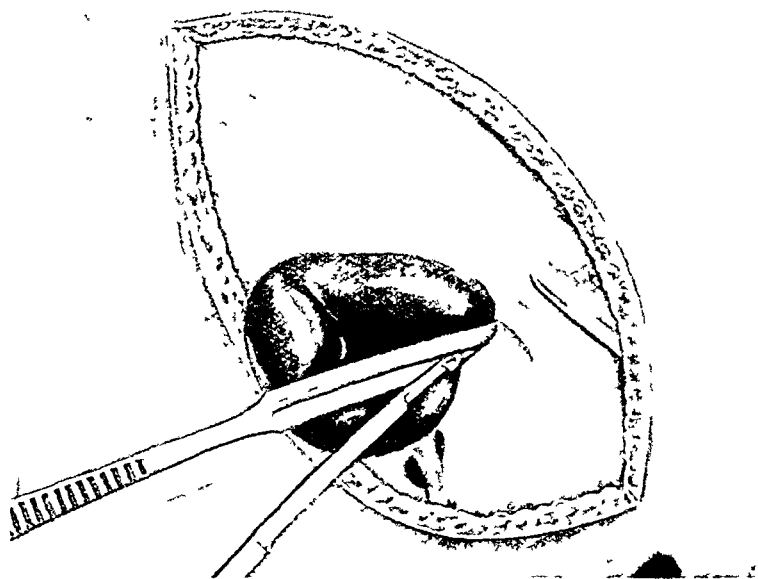


FIG 13 Hernia knife passed along hernia director to divide the neck of the sac

The stricture having been carefully and sufficiently nicked, the bowel is gently drawn down and examined, especially where it was constricted and also above this point. If it is healthy it is replaced either by gentle squeezing between the finger and thumb, so as to empty it of its contents, or with the pressure of the little finger, the sac being now kept stretched with forceps so that no folds interfere with the return of the bowel. If pressure on one part of the intestine fail, it must be tried at another point. After the reduction of the intestine a finger should be introduced through the crural canal into the peritoneal cavity to ascertain that the gut is absolutely safe within the peritoneal cavity and not kinked round omentum adherent at the neck of the sac.

If the patient's condition admit of it, the sac should next be removed after rapidly separating it by gauze dissection from its attachments. It should then be pulled well forwards and its neck ligatured with catgut as

high up as possible and the sac cut away well below the ligature. Unless the condition of the patient is grave or the tissues have been infected from foul contents of the sac the femoral ring is closed in one of the ways described at p 71. The superficial wound is closed and the dressings are applied with sufficient care to keep the wound secure from obviously close sources of contamination.

The account of an ordinary operation having been given it remains to consider certain complications. These are chiefly

(1) *Adhesions of Bowel to the Sac or Omentum.* The treatment of this uncommon complication must vary with (a) the character and position of the adhesions (b) the condition of the intestines and (c) the state of the patient. Owing to the difficulty of fitting on a truss if any of the hernia is left unreduced every attempt should be made to free the contents by separating adhesions or by tying and excising omentum adherent to the sac. No intestine and omentum still adherent to each other should ever be returned. A few cases remain in which adhesions should be left alone. When gangrene is threatening but the operator is too short handed to face resection of the affected intestine the presence of adhesions especially about the neck of the sac is the chief safeguard against extravasation into the peritoneal cavity. In some cases of large hernia if the patient be much collapsed so long as any recently descended loop is returned any long adherent intestine may be left. And in other cases of collapse from delay of the operation where there is much difficulty in returning a loop of intestine especially if this be not in good condition it may be left after the stricture has been sufficiently divided.

(2) *Tightly Constricted or Gangrenous Intestine.* In spite of all that has been taught about the importance of early operations cases do still occur in which returning the bowel is doubtful or out of the question. Nothing is more difficult than to decide upon the treatment of the intestine in doubtful cases. A prompt decision must be made after a careful examination of the intestine mesentery and contents of the sac and the general condition of the patient will influence the decision.

(a) *The Intestine.* It is imperative to examine not only the loop in the sac but also the part constricted at the neck and the obstructed dilated perhaps irrecoverable bowel above the constriction. Here nothing will surpass the advice of Sir J. Paget.¹ You are to judge chiefly from the colour and the tenacity. Use your eyes and your fingers sometimes your nose very seldom your ears for what you may be told about time of strangulation sensations and the rest is as likely to mislead you as to guide aright. As to colour I am disposed to say that you may return intestine of any colour short of black if its texture be good if it feel tense elastic well filled out and resilient not collapsed or sticky and the more the surface of the intestine shines and glistens the more sure you may be of this rule. When a piece of intestine is thoroughly black I believe you had better not return it unless you can be sure that the blackness is wholly from extravasated blood. It may not yet be dead but it is not likely to recover and even if it should not die after being returned there will be the great risk of its remaining unfit to propel its contents and helping to bring on death by what appears very frequent—distension and paralysis of the canal above it. But if indeed utter black

¹ *Loc. sup. cit.* p 133

ness of strangulated intestine commonly tells of gangrene already ; and of this you may be sure if the black textures are lustreless, soft, flaccid or viscid, sticking to the fingers, or looking villous. Intestine in this state should never be returned. Colours about which there can be as little doubt, for signs of gangrene, are white, grey, and green, all dull, lustreless, in blotches or complete over the whole protruded intestine. . . . Then as to the texture of the intestine ; it should be, for safety of return, thin-walled, firm, tense, and elastic, preserving its cylindrical form, smooth, slippery, and glossy. The further the intestine deviates from these characters, the more it loses its gloss and looks villous, the more it feels sticky and is collapsed and out of the cylinder form, the softer and more yielding, the more pulpy, or like wet leather or soaked paper, the less it is fit for return." It is very important to notice whether the blood returns quickly or sluggishly to a portion of the loop of bowel which has been rendered anæmic by the pressure of the finger. It should always be remembered that, although the bowel may not be actually gangrenous, it may slough or perforate soon after its reduction, and that in many cases more, without any perforation, the intestinal wall may be so severely damaged as to allow the escape of the virulent germs within it into the peritoneal cavity, inducing rapidly fatal peritonitis. A number of patients also die from paralytic distension, and a few from enteritis, or profuse hæmorrhage from the bowel. The dangerous condition of the distended bowel above the obstruction is too apt to be forgotten, it is often in a condition of infiltrating septic inflammation, and its contents are highly poisonous, and owing to paralytic distension drainage is rarely successful in removing this toxic accumulation. Under these circumstances a sufficiently extensive resection, swiftly performed, offers the best chance of recovery.

The late Mr. A. E. Barker¹ found that more than half of 127 deaths following herniotomy were due to the reduction of too severely damaged bowel.

(b) If the mesentery is greatly thickened and firm from inflammatory œdema or intestinal hæmorrhage, if its veins are thrombosed and its arteries cannot be felt to pulsate, then it is clear that the loop of bowel ought not to be returned into the abdomen but must be resected.

(c) The nature of the fluid in the sac is also of importance, for if it be foul and sanious it indicates that the conditions of the loop of bowel is so bad as to allow infection through the damaged walls, and the risk of peritonitis incurred by returning such intestine is great.

In other long-standing cases of femoral hernia the chief stress of the constriction is shown, not in a dying loop of intestine, but by ulceration, partial or nearly ring-like, at the neck of the sac, under the sharp edge of Gimbernat's ligament. Where this condition, owing to the duration of the case, is suspected the intestine should be very gently drawn down and carefully examined ; if only a grey or white line be found, this may be inverted by means of a Lembert suture and fortified by a mesenteric flap or omental grafts, and the bowel, which is otherwise recoverable, may be returned. It is always important to examine the condition of the distended bowel above the obstruction. If this is good a damaged loop of bowel may often be safely returned after making a lateral anastomosis between healthy bowel above and below the loop. The risk of perforation

¹ *Lancet*, 1903, i, 1495.

is thus diminished and a more dangerous resection is avoided. The damaged loop is left just above the neck of the sac which is not closed. The alternative of leaving a doubtful loop of bowel in the wound for twenty-four hours after dividing the stricture is not so satisfactory for the bowel is more likely to recover when returned into the abdomen where adhesions soon take place between it and the neighbouring coils.

When it has been decided that the bowel cannot be reduced without undue risk the surgeon has to decide between (a) Enterostomy (b) Resection and (c) Entero-anastomosis. Wherever possible i.e. where the condition of the patient and the experience and help ready to the surgeon's hand admit of his taking this step the dead or dying intestine should be resected.

(a) In a few cases where the above conditions are absent the surgeon must rest content with opening the intestine leaving it *in situ* and thus draining the distended bowel above.

A small incision is made on the convexity of the affected loop and a long rubber tube with two side holes near its inner end is thus passed into the distended intestine within the abdomen. It is secured to the bowel by a suture which also closes the aperture around the tube. It is unfortunately true that although the tube may be passed well into the distended bowel within the abdomen very little of the pints of putrescent fluids drains away in the worst cases owing to paralysis of the intestine. Few cases which are so desperate as to be suitable for the formation of an artificial anus ultimately recover. In a series of 406 cases of strangulated hernia at University College Hospital¹ only two out of twenty recovered after this procedure. The reasons for this high mortality are chiefly the desperate general condition of the patient at the time of the operation which is followed by shock, septic peritonitis from the condition of the distended bowel within the abdomen, suppuration and sloughing in the wound and lastly the mortality of the secondary operation which is usually necessary to close the fecal fistula is high in these cases. Shock, toxæmia and pulmonary complications can be minimised by doing the primary operation under local anaesthesia as recommended above.

(b) *Resection* The present high mortality of strangulated hernia will be very considerably lowered chiefly by earlier operation before the intestine becomes seriously damaged and to a lesser degree by speedy and careful primary resection in late cases when the bowel is dead or dying.

It is important to remember that resections are rarely wide enough; it is of little use to resect the strangulated loop without also removing the distended paralysed bowel above the obstruction. Mr Barker² laid great stress on the removal of enough of this inflamed and damaged bowel—up to six feet of small intestine may be removed if necessary without greatly increasing the shock of the resection and without interfering seriously with subsequent nutrition. Between 1899 and 1903 Mr Barker performed seven extensive enterectomies for strangulated hernia with only two deaths, one of these dying from the pressure of an old fibrous band on the bowel after its return into the abdomen and another from peritonitis which was probably due to infection from a sup-

¹ Barker *loc. cit.*

² The operation of Resection is described in Chapter XX.

³ *Loc. cit.* at 176 of 1901 i. 1186.

purating hernial sac, which was not drained externally. Hofmeister¹ also published twenty-five primary resections with a mortality of 40 per cent.

It is perhaps needless to say that these resections will always have a high mortality even in the hands of those who have taken pains to acquire skill, speed and care in intestinal surgery, but every recovery means a life saved. The writer has successfully resected a gangrenous loop in a lady over eighty years of age. For those patients presenting themselves when *in extremis* enterostomy still remains the most suitable treatment. In some cases resection and enterostomy can be combined with advantage, a tube being inserted in a water-tight manner in the bowel several inches above the anastomosis (*see* p. 268) and the bowel returned into the abdomen.

(c) *Entero-Anastomosis*. Estapé,² having found the intestine gangrenous in the sac, has covered it, opened the abdomen, through a separate incision, and successfully anastomosed the bowel above and below the strangulation. The abdomen was closed, but the hernial wound left open. The strangulated loop sloughed, but the wound gradually healed without further operation. To prevent fecal fistula, the bowel proximal to the strangulation but below the anastomosis may be tied and divided, the tied ends being buried with purse-string sutures.

(3) *Wound of Intestine*. This may be due to (a) carelessly incising thin, soft parts; (b) great difficulty in making out the sac and the intestine in a fat patient, with the parts matted, especially if the light is bad; (c) to the intestine being allowed to curl over the edge of the director while the stricture is being divided, or to this being cut with careless freedom, or, lastly, to a loop lying out of sight just above the constriction. and to the hernia knife coming in contact with this. Any bubbling or smell of flatus or escape of feces must lead to a careful search for the wound. The operation wound being freely enlarged, the wound in the intestine found, temporarily closed with forceps, and drawn out of the abdomen, the intestines around are cleansed and packed out of the way, and the wound closed by two layers of suture, without narrowing the lumen of the bowel (*see* Suture of the Intestine).

(4) *Wound of Obturator Artery*. The position of this vessel when it rises by a common trunk with the deep epigastric instead of from the internal iliac, which occurs in two out of every seven (Gray), may bear a very important relation to the crural ring. In most cases when thus arising abnormally the artery descends to the obturator foramen close to the external iliac vein, and therefore on the outer side of the crural ring and out of harm's way. In a small minority of cases the artery in its passage downwards curves along the margin of Gimbernat's ligament, where it may be easily wounded.

The treatment is mainly preventive—i.e. by making the smallest possible nick that will be sufficient into any constriction, such as Gimbernat's ligament, a point the importance of which has already been alluded to (p. 22), and by using a hernia knife that is not over-sharp, and above all by opening the inguinal canal after Lotheissen's method of radical cure and seeing Gimbernat's ligament from above, an abnormal artery is thus easily seen and avoided. If the artery has been wounded, the following points are of interest: (1) The hæmorrhage

¹ *Beit. Z. Klin.*, Bd. xxviii, H. 3.

² *Rev. Espan. de Med. y Chir.*, 1919, Nov. P. 595.

may not at once follow the wound. It may not make its appearance till the bowel is all reduced, or even until a quarter of an hour after the wound has been stitched up. In one case that of Dupuytren, no hæmorrhage occurred, and the division of the artery was discovered for the first time at the necropsy three weeks after the operation. (2) It may occur when the sac has not been opened. (3) As is shown by Dupuytren's case, it is not necessarily a fatal accident. (4) Very various means have served to arrest the hæmorrhage. (a) Pressure, as in the cases of Sir W. Lawrence, Mr. Hey, and Mr. Barker.¹ This means was successful in two out of the three cases in which it has been employed. It should only be resorted to when the patient's condition does not admit of the bleeding points being found and dealt with by ligature. If pressure has to be trusted to, it should be efficiently employed by means of sterile gauze. (b) Ligature of the vessel, usually the proximal end. Of five cases given by Mr. Barker this was successful in four, it is only stated in one that the distal end was also secured. The ligature had been applied in some cases by continuing the wound upwards, in others by making an incision parallel with Poupart's ligament as if for tying the external iliac. The best way to expose the artery is through the inguinal canal after Lotheissen's method of radical cure of femoral hernia (p. 73), both ends of the artery must be tied.

STRANGULATED INGUINAL HERNIA

Operation. In considering this it will not be needful to go again into detail, as in the case of Strangulated Femoral Hernia, the chief points of difference and those of importance will be considered carefully.

The parts being shaved and cleansed, and the thigh a little flexed, an incision four inches long at first is made in the long axis of the tumour, with its centre over the internal abdominal ring. The superficial epigastric vessels are secured and tied. As the layers are divided, the knife being kept strictly in the same line throughout, the tendinous fibres of the external oblique are exposed with some arching fibres of the inter columnar fascia below. The inguinal canal is freely opened, and the cremasteric fascia, often thickened, is identified and incised. After this the transversalis fascia, also much thickened and vascular looking, is slit up, and any extra-peritoneal fat overlying the greyish blue sac looked for. The surgeon now sees if he can find any constricting fibres outside the sac, and divides them. The sac is opened, the contents are thoroughly examined, omentum got rid of if this step will give more room, and the site of stricture² found with the finger or tip of the director. It is next divided with the hernia knife manipulated under it in a direction straight upwards, so as to be parallel with the deep epigastric, whichever side of

¹ *Clin. Soc. Trans.*, xi, 180. This paper will well repay perusal.

² The site of the stricture in inguinal hernia varies. In both varieties, in old cases of long duration it is usually situated in the neck of the sac itself, owing to contraction and thickening of this and the extra-peritoneal tissue. In other cases of oblique hernia the stricture is found in the infundibuliform fascia at the internal ring just below the edge of the internal oblique in the canal, or at the external ring. In a direct hernia the constricting point, if not in the sac, is probably caused by the fibres of the conjoint tendon. In many cases the parts are so approximated and altered that in the short time given for an operation it is not so easy to tell exactly in what tissues lies the strangulation, as to relieve it. Finally, in many cases of young subjects and acute strangulation muscular spasm, e.g. of the internal oblique, must be borne in mind.

the hernia this vessel occupies.¹ During this stage the steps given at p. 21 must be taken to avoid any injury to the intestine. The constricting point being divided and dilated, the next step is **reduction of the intestine**. This, in bulky inguinal herniæ, is often a matter of difficulty and time. The **chief causes of difficulty here** are : (1) A large amount of intestine, one or two coils of small and some large intestine being not very uncommon. (2) The distension of these with flatus, &c. (3) Insufficient division of the stricture, or there may be a point of stricture higher up than the one divided, and overlooked. (4) During attempts at reduction one bit of intestine may get jammed across the ring instead of slipping up along it, and against this the rest of the contents are fruitlessly pressed. (5) Folds of the sac may in much the same way block the opening.

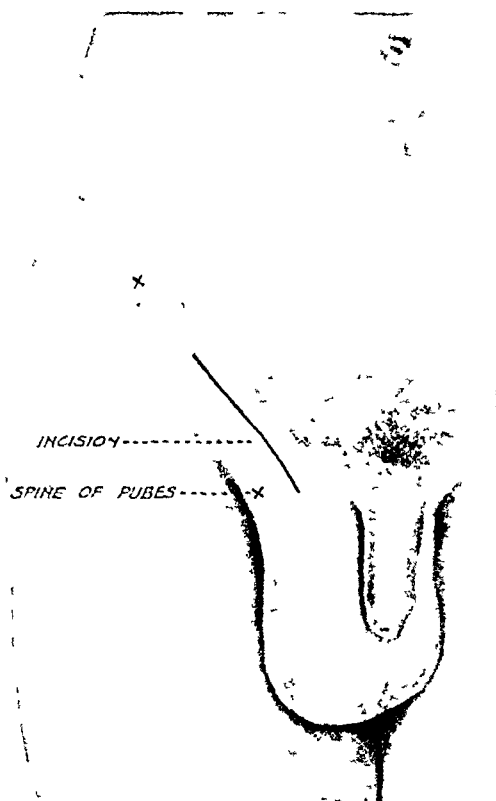


FIG. 14. The site of the incision for strangulated inguinal hernia.

Aids in Difficult Cases. First, that part which lies nearest the ring should be taken, *e.g.* mesentery before intestine. After each part is got up, pressure should be made on it for a few seconds before another is taken in hand. If the surgeon find, after a while, that he is making no progress with one end of a coil, he should take in hand the other end, or another coil altogether if more than one be present. Much of

¹ Of course, if the surgeon is certain that he is dealing with an oblique hernia he may cut outwards, and, in the case of a direct hernia, inwards, so as to avoid the deep epigastric. In all cases the cut should be of the nature of a nick dividing only those fibres which actually constrict, any additional dilation being usually now effected by the tip of the director or finger.

the difficulty met with in the reduction of the intestine is due to the surgeon not first unravelling the coil or coils not duly tracing up the intestine to the ring so as to make out the relations of the two, and, above all, to his not making up his mind which end of the coil it is exactly which he intends to begin reducing. During the manipulations the thigh should be flexed and rotated a little inwards, and the cut edges of the sac drawn tense with forceps so as to prevent any folding or pushing up of this before the intestine. If the intestines are much distended attempts should be first made to return some of their contents. If after gentle squeezing with the finger and thumb and careful pressure upwards on each successive bit of intestine it all appears to be returned the index finger must be passed into the abdominal cavity to make certain that no knuckle remains in the canal or internal ring.

Cases will occasionally be met with where owing to the low condition of the patient the large amount of intestine down its great distension its altered condition still red and not only congested but softened with the peritoneal coat shaggy rather than lustrous and tending to tear easily. It is clear that reduction will not be effected by manipulation only. After carefully packing round a distended loop flatus may be released by puncturing with a fine trocar or an ordinary cutting needle. If this does not relieve the distension liquid feces may be drained away through a cannula and a long piece of rubber tubing. The perforation is closed and inverted by means of a purse string suture introduced before the puncture is made and tightened as the cannula is withdrawn. Where the intestine is much congested and softened though not yet gangrenous or where the surgeon has not skilled assistance and all the aids of modern surgery ready to his hand he had better leave the intestine in the sac after a free division of the stricture.¹ This method while under the above conditions the safer prevents of course any attempt at relieving the patient at one operation by a radical cure. For a consideration of the points which may aid in deciding on the treatment of bowel in a doubtful condition or in a gangrenous state the reader is referred to p. 23.

When the intestine is all reduced any ligatured stumps of omentum are returned and if the condition of the patient admit of it the sac is detached one of the methods of radical cure given at pp. 44 to 69 being carefully followed.

After thus considering the chief points in the operation it remains to draw attention to some special points connected with inguinal hernia.

I. Varieties. In addition to the oblique and direct varieties both of which are acquired, there are some others of much practical importance.

¹ This will gradually and slowly return into the peritoneal cavity. On this point the following case by South (*Chelius's Surgery* ii. 40) is of interest. I know by experience that if strangulation be relieved it is of little consequence how much intestine be down. In reference to this point I recollect the largest serotal rupture on which I have operated and in which before the division of the stricture there was at least half a yard of bowel down, filled with air and after the stricture had been cut through at least as much more thrust through so that I almost despaired of getting any back yet after a time I returned the whole. To my vexation however next morning I found that my patient had got out of bed to relieve himself in the chamber pot and as might be expected the bowel had descended and in such quantity that the scrotum was at least as big as a quart pot and the vermicular motion of the intestine was distinctly seen through the stretched skin. Nothing further was done than to keep the tumour raised to the level of the abdominal ring and by degrees it returned and the patient never laboured under any symptom.

e.g. (a) Congenital hernia into the funicular process of peritoneum. Here the tubular process of peritoneum is divided into a shut vaginal sac below and an open funicular process above. Into the latter the contents descend, but are not in absolute contact with the testis. (b) Congenital hernia into the tunica vaginalis; the tubular process of the peritoneum is open from the abdomen to the fundus scroti, and the contents lie in contact with the testis. A careful study of the herniæ of infants and children proves that this variety is very much rarer than the first variety. (c) Hour-glass contraction of the sac. Here the tubular process is open as in (b), but an attempt at closure has brought about a constriction which may be at the external abdominal ring or lower down in the scrotum. If the contents pass through this constriction and get low enough, they will be in actual contact with the testis. (d) Encysted hernia of the tunica vaginalis. Here the funicular process is closed at its upper extremity, *i.e.* at either ring or in the canal, and open below to the testicle. The hernial protrusion as it comes down either ruptures this septum (when of sudden descent), or gradually inverts it, or comes down behind it. These cases are rare, but may be puzzling when they occur, as the operator has more than one layer of peritoneum to incise before reaching the contents. (e) Interstitial hernia, in which the sac, and often the testicle, lie between the internal and external oblique muscles. The writer operated on an infant in which the condition was bilateral; there were no external rings, yet the cords were long enough for the testes to be easily brought into the scrotum.

That the above varieties have an importance beyond that of anatomical puzzles is shown by the fact that in (a), (c) and (d) strangulation may be very acute and urgent. Again, though the defect is a congenital one, the hernia does not, in many cases, make its appearance till the patient has, in early adult life, been subjected to some sudden strain. Finally, in these cases any prolongation of the taxis will be not only futile but actually dangerous, owing to the tightness of the strangulation and the facility with which, from the delicacy of its adhesions, the sac may be separated or burst.

II. *Reduction en Masse, and Allied Conditions.* These have been chiefly met with in inguinal herniæ owing to the loose connections of the sac and, sometimes, to the force used in attempts at reduction. Strangulation may persist after (a) displacement, or (b) rupture of the sac. In the former the sac, still strangling its contents, is displaced bodily between the peritoneum and extra-peritoneal fascia. In the latter the sac is rent, usually close to its neck and on its posterior aspect, and some of its contents are thrust through into the extra-peritoneal connective tissue. The chief evidence of these accidents is that, though the swelling has disappeared, perhaps completely, this has taken place without the characteristic jerk or gurgle. On close examination, though the bulk of the hernia is gone, some swelling, often tender, is usually to be made out, deep, in the neighbourhood of the internal ring. Above all, the *symptoms persist*, perhaps in an intensified form.

The treatment is immediate exploration of the inguinal canal and the internal ring. If the cord is exposed, the whole sac has probably been detached. If any of the sac is left in the canal, a rent in its neck should be sought for. If necessary the lower fibres of the internal oblique muscle may be separated to expose the displaced neck of the sac.

III Retained Testis simulating Hernia Such a testis, when inflamed or twisted on its mesorchium, which is often long enough to allow this, may closely simulate strangulated hernia. A testis, perhaps, has never descended, a truss has been worn and laid aside. The patient presents himself with a tender swelling in one groin, with indistinct impulse. The abdomen is tense and full constipation is present and perhaps vomiting of bilious fluid. Such a swelling should be explored and the testis removed, as it is certain later on, to cause serious trouble, even if the present urgent symptoms subside with palliative treatment. In other cases a retained testis may draw down an adherent loop of intestine which may become actually strangled.

STRANGULATED UMBILICAL HERNIA

Two distinct forms of strangulated hernia will be met with here. One more rare is of small size with a single knuckle of intestine acutely strangled in the navel cicatrix. The other the more common is often huge, its contents mixed—intestine both large and small and omentum. Such herniae soon become in part at least irreducible when in this condition any unwise man may readily bring about obstruction a condition requiring much care to tell from strangulation.¹ In other cases a large irreducible hernia may easily become strangulated from the descent of some additional loop of bowel. The adequate fitting of a truss is often a matter of much difficulty here owing to the large size of the abdomen the presence of adherent omentum and frequently of an habitual cough.

Practical Points before Operation (α) The sac usually communicates directly with the general peritoneal cavity by a large opening. (β) The contents are not only mixed but of long standing and often adherent. (γ) The patients are often advanced in life obese flabby and not infrequently the subjects of chronic bronchitis. (δ) The coverings are ill nourished and slough easily.

Operation In view of the delicacy of the skin and the intertrigo which is often present, the cleansing must be thorough but gentle. An anæsthetic having been administered a curved transverse incision two to three inches long is made across the lower² aspect of the neck of the swelling, the hernia being pushed upwards to facilitate this.³ The coverings are much thicker and more easily distinguished here than over the

¹ Amongst the most important points will be the vomiting whether early in onset constant and showing signs of becoming feculent, and the constipation whether absolute even to the passage of flatus. In doubtful cases the rule should be to operate. The risk of operating on a hernia which is inflamed and not easily reducible is very small in comparison with the risk of leaving one which is inflamed and strangulated and even if you can find reasons for waiting it must be with the most constant oversight for an inflamed and irreducible hernia may at any time become strangulated and will certainly do so if not relieved by rest and other appropriate treatment. (Sir J. Paget *loc. supra cit.* p. 106)

² The lower part is here recommended because in Mr Wood's words (*Intern. Encycl. of Surg.* v. 1163), "the point of strangulation in an adult umbilical hernia is most frequently at the lower part of the sac where the action of gravity, the dragging weight of the contents and the superincumbent fat together with the pressure and weight of the dress or an abdominal belt combine to press downwards upon the sharp edge of the abdominal opening. It is here that adhesions and ulceration of the bowel are most frequently found and here the surgeon must search for the constriction in cases of strangulation."

³ If the surgeon intends to attempt a radical cure and if the skin is diseased much thickened with chafed rashes he should remove this area by a transverse elliptical incision.

fundus of the hernia, where it is easy to injure the contents. Moreover, the contents are rarely adherent at the very neck of the rupture. The ring, and the aponeurosis for two inches below it, are thoroughly exposed. The sac must be opened, and slit up, care being taken now and throughout the operation, in cases of large herniæ, that protrusion of intestine be prevented by the means given a little later. The contents having been examined, any intestine is gently displaced upwards, while the surgeon turns the curved surface of a Key's director over the edge of the opening, and, guiding the hernia knife on this, divides the constricting edge laterally. If sufficient space is not given, the nick may be repeated, or the director turned against the other side of the ring, and some fibres here also divided.

Adhesions of the contents of the sac are not infrequently met with. Any adherent omentum is tied and divided near the neck of the sac. If the adhesions concern the bowel and are very close and dense, and if the condition of the patient is unsatisfactory, the surgeon should be content with a free division at one or two places of the constricting ring, and with reducing any portion of intestine that has clearly only recently come down, and leave the rest undisturbed.

In late cases care must be taken to prevent protrusion of the intestines from the abdomen by vigilant pressure and deep anæsthesia. If the bowels are allowed to prolapse it may be very difficult to replace them, and the manipulations required increase shock. It is, however, important to examine the proximal bowel within the abdomen, for this may be gangrenous or irrecoverable. Some years ago the writer, operating in a cottage on an old woman weighing over 18 stone, had just completed a resection of gangrenous cæcum and ascending colon, with end to side union of the ileum to the transverse colon, when he discovered another gangrenous loop of the ileum within the abdomen. This, together with the end of the ileum engaged in the anastomosis, was excised, and a new end to side union was successfully made.

All the intestine and the remains of the omentum, carefully ligatured, having been returned if possible, the surgeon now, if the patient's condition admits of it, removes the redundant sac and skin by joining the ends of the first incision by another one passing across the upper aspect of the neck of the rupture. The opening into the abdominal cavity is closed in the following manner: The sac is carefully separated all round till its neck is cleared, the redundant part is cut away, and the peritoneum closed by means of a continuous catgut suture. The operation is completed by rapidly performing one of the forms of radical cure described on p. 76. Mayo's operation is simple and by far the best. Attempts to draw the edges of the fibrous ring together without the aid of flaps are to be condemned, because the sutures are very apt to tear out even during the operation, and much more so during the vomiting that may follow it.

It will be seen from the above account that two methods may be pursued in the treatment of a strangulated umbilical hernia: (1) If the surgeon be short-handed and the hernia very large or the patient's general condition grave, the ring is freely divided at one or two points, but the contents disturbed as little as possible, any recently descended intestine being returned, but thickened omentum and adherent intestine (especially

large) being left undisturbed (2) Free opening of the sac examination and separation of its contents return of all intestine and of omentum after ligature and excision of some of the latter

While the second of these courses has the great advantage of leaving the patient permanently in a more satisfactory condition as it admits of a radical cure the surgeon can only rightly decide between this and the first course by a careful consideration of each case The following points may aid in judiciously selecting either operation (1) The size long standing previous attacks of incarceration and obstruction of the hernia all these tending to bring about adhesions and alterations in the parts (2) The condition of the patient viz the degree of flabby fatness chronic bronchitis probable renal and hepatic disease amount of depression by vomiting and pain (3) The presence of the skilled help so essential in these cases (4) The way in which the anæsthetic¹ is taken (5) The amount of experience of the operator Thus a hospital surgeon frequently operating and with all instruments and assistance at hand may readily incline to one course while the other may as wisely be followed by a surgeon who has to operate under very different circumstances For a consideration of the treatment of damaged intestine see p 23

STRANGULATED OBTURATOR HERNIA

This form of hernia has occurred too frequently to be entirely passed over It may be so readily and fatally overlooked that a few words on its *diagnosis* will not be out of place

(1) Position of the swelling This appears in the thigh below the horizontal ramus of the pubes behind and just inside the femoral vessels behind the pectineus and outside the adductor longus (2) On careful comparison of the outline of Scarpa's triangles a slight fullness is found in one as compared with the hollow in the other (3) Pain along the course of the obturator nerve down the inner side of the thigh knee and leg (4) *Persistence of symptoms of strangulation the other rings being empty* or occupied by reducible hernia (5) A vaginal or rectal examination In making these examinations in cases of intestinal obstruction care should always be taken to examine the pelvic aspect of the obturator foramen

Operation Two alternatives present themselves (i) cutting down on the sac as in other herniæ (ii) abdominal section and withdrawing the loop from within

(i) The parts having been duly cleansed and slightly relaxed an incision is made parallel to and just inside the femoral vein and extending a little above Poupart's ligament The saphenous opening being probably exposed in part the fascia over the pectineus and the fibres of this muscle having been divided transversely for one and a half or two inches the obturator muscle covered by its fascia and some fatty cellular tissue is next defined and the hernial sac probably now comes into view either between the muscle and the pubes or between the fibres of the muscle The sac must be opened and if any constriction has to be divided the knife should be turned either upwards or downwards the latter being the easier if no constricting fibres intervene between the sac and the bone

¹ Local and regional anesthesia is very valuable in bad cases especially when complicated by bronchitis In such a patient breathing sixty times a minute the author successfully resected the greater part of the transverse colon which was gangrenous

As the obturator vessels lie usually on one side or the other, a lateral incision must be avoided.

Care must be taken to keep the femoral vessels drawn outwards with a retractor, while any branches of the obturator or anterior crural nerve are drawn aside with a blunt hook, the same precaution being taken with the saphena vein.

When by the passage of the little finger into the abdomen it is certain that the intestine is reduced, if the condition of the patient admits of it the sac is separated and ligatured close to the thyroid foramen and removed.

(ii) The operation of abdominal section will be more frequently performed in the future, because it is far easier and allows a more complete examination and treatment of damaged intestine.

An obturator hernia was thus reduced by Mr. Hilton in a case which simulated intestinal obstruction. Some empty intestine being found and traced downwards led to the detection of an obturator hernia, which was reduced by gentle traction, aided by firm pressure made deeply in the thigh. The patient, who was not operated on till the eleventh day, died of peritonitis.

In 1914 I reduced a small gangrenous enterocoele in this way in a feeble old lady on the fifth day of strangulation. Entero-anastomosis combined with drainage of the perforated loop proved successful. The anastomosis was 6 inches above and 3 inches below the perforation.

Before drawing the strangulated bowel into the abdomen it is important to introduce a gauze pack into the pelvis, and to clamp the bowel just above the neck of the sac to prevent the possibility of faecal contamination. The constriction is then nicked downwards with a hernia knife. the intestine withdrawn and treated, and the hernial orifice closed from within the abdomen.

Question of the advisability of reducing Strangulated Hernia by Abdominal Section.

This question having arisen here may be dealt with once for all. Cases will occur from time to time, such as Mr. Hilton's, in which, evidence of acute intestinal strangulation existing and no hernia being detected externally, on the abdomen being opened the cause will be found to be a piece of a small intestine nipped in part of its circumference, probably in either one of the femoral or obturator rings. Still more rarely a surgeon may find such difficulty in reducing an obturator hernia from without that he feels himself driven to resort to abdominal section. More frequently he may find the bowel gangrenous in an obturator hernia. It is to be remembered that the rupture is often a partial enterocoele with dubious symptoms which have delayed treatment. If the patient's condition be fairly good, resection is then indicated, and can only be performed through a laparotomy wound. An incision should be made through the corresponding rectus low down, the Trendelenburg position adopted, and the limbs of the loop of bowel which are within the pelvis clamped with Doyen's intestinal forceps. The constriction should be divided in a downward direction, and the strangulated intestine withdrawn into the pelvis and then out of the abdomen, where it can be thoroughly examined and resected if necessary. Should the sac be suppurating it can be drained through a wound in the thigh. Some years ago it was suggested that it should be the rule to reduce herniæ generally, and to perform the radical cure by abdominal section. Thus at the meeting

of the British Medical Association in 1891¹ this question was discussed the late Mr Lawson Tait introducing the subject. As might be expected the proposal to abandon the old operation and substitute treatment by median abdominal section met with no support from those surgeons who know anything of operations for strangulated hernia in hospital practice especially in males. Save in the rarest cases such as those belonging to the category I have mentioned such a step is to be condemned in the strongest terms for the following reasons. (1) The old and well-established operation is one *per se* of but slight severity and one that usually can be kept extra peritoneal by an operator of ordinary skill and of average anatomical knowledge. Those who would substitute abdominal section forget that however safe they may consider themselves with their especial experience neither they nor any one else can prevent the *shock* which goes with intra peritoneal operations a complication which is certainly to be avoided in patients exhausted by a strangulated hernia. (2) The reduction of the intestine which is spoken of as so easy after abdominal section by those who advocate this method is liable to be prevented by adhesions to the sac &c when such exist—and no one can foretell this point the sac must be explored in the usual way. (3) There is a very grave risk that the intestine is tightly nipped and often may give way when pulled upon through a median incision. Those who advocate abdominal section will say that the resulting extravasation can be met by packing &c. It will be well for all such to remember the following advice tersely put by Sir W. Bennett. "Let it be noted that it is generally far more easy to soil the peritoneum than to cleanse it." The same surgeon points out that the fluid found in the sac of herniæ when strangulation has long existed is sometimes dark and ill smelling though no lesion may be apparent in the gut itself. By an ordinary herniotomy such fluid is thoroughly drained away from the peritoneal cavity and any such intestine is cleansed before it is put back or otherwise appropriately dealt with. (4) All operating surgeons are agreed that whenever the condition of the patient admits of it an operation for strangulated hernia should be completed by giving the patient at least a chance of radical cure. I am distinctly of opinion that no intra peritoneal operation yet described will secure radical results in inguinal herniæ. (5) Those who think they are improving matters by substituting abdominal section for the old established herniotomy object to the latter on account of its tendency to weaken the abdominal wall by the incision made to reach and relieve the constriction. Such advocates forget the criticism pithily put forward during the above discussion by Mr Keetley that treatment of herniæ by abdominal section created two potential hernial apertures where there was originally but one.

Causes of Persistence of Symptoms after Herniotomy. Most of the bad results are due to delay before operation and the reduction into the abdomen of bowel in a severely damaged state resulting in—

- (1) Peritonitis indicated by general abdominal tenderness rigidity tympanites and vomiting.
- (2) Collapse from exhaustion.
- (3) Lung complications such as bronchitis septic pneumonia pulmonary embolism.
- (4) Sepsis suppuration in the wound.
- (5) Enteritis and hæmorrhage.

¹ *Brit Med Journ* September 26 1891

² *Clin Lect on Her* a p 1^o

from the bowel. The eight following are the causes of intestinal obstruction after operations for hernia: (6) The descent and restrangulation of the bowel. (7) So much damage to the intestine that it lies paralysed in the peritoneal cavity.¹ (8) Cicatricial stricture of the intestine. (9) Fixing of the bowel, after its reduction, by adhesions to the abdominal wall. (10) Formation of a band out of the above adhesions. (11) Fixing of the two ends of a loop of intestine by adhesions. (12) Formation of an omental band in the neighbourhood of one of the hernial orifices, a band so formed causing obstruction later.² (13) A very rare condition. The sac may be multilocular; when the intestine is reduced it may be returned into one of these cavities instead of within the abdomen. Mr. Bellamy has published such a case.³ A good illustration of this is given in Mr. Holmes's *Surgery*, p. 698, Fig. 322; the patient here died eight days after an operation for strangulated hernia. (14) Reduction *en masse* at the operation. This is most likely to happen in femoral hernia, the fascia propria being mistaken for the sac.

Mortality.—At the discussion on intestinal obstruction at the Bath Meeting of the British Medical Association in 1925,⁴ the combined statistics for hernia from seven British hospitals, for the five years 1920-24, were as follows: inguinal hernia, 534 cases with a mortality of 16 per cent.; femoral hernia, 675 cases with a mortality of 20 per cent.; and umbilical hernia, 200 cases with a mortality of 35 per cent.

The 106 cases admitted to Guy's Hospital during that period, and collected by Mr. B. L. Laver, are divided as follows: inguinal hernia 48, with 27·1 per cent. mortality; femoral hernia 43, with 18·5 per cent. mortality; and umbilical and ventral hernia 15, with a mortality of 46·6 per cent.

RADICAL CURE OF HERNIA

Before describing the different methods the following points claim attention; and while the improvements of modern surgery have long established radical cure on a sound scientific basis, many questions have to be considered. The chief of these are: The mortality of the operation. The use of the terms "radical cure" and "permanence of the cure." The earliest age at which the operation is advisable in children. The advisability or need of wearing a truss afterwards. The best material for suture. The best form of operation.

The Mortality of the Operation. The following statistics show what modern surgery and experienced hands can do: Coley and Hoguet,⁵ in an analysis of the results of 8,589 radical operations for hernia from 1891 to 1918, found that from December, 1890, to January, 1901, a period of ten years, 2,732 cases were operated on at the Hospital for Ruptured and Crippled, with 6 deaths or 0·22 per cent.; from January, 1901, to January, 1918, 3,358 were operated upon, with 5 deaths or 0·15 per cent.

The Value of the Term "Radical Cure," and the Permanence of the Cure after Operation. In recent years we have learnt more accurately

¹ Mr. Jacobson recorded (*Brit. Med. Journ.*, 1879, ii, 491) an instance of this in which, ten days after an operation for intestinal obstruction by bands, death took place from the intestine never having recovered itself.

² *Brit. Med. Journ.*, 1879, ii, 491.

³ *Lancet*, 1886, ii, 433.

⁴ *Brit. Med. Journ.*, 1925, ii, 1000.

⁵ *Ann. of Surg.*, 1918, lxxiii, 264.

the principles on which this operation is to be conducted. Two or three methods have been employed on such a large scale, and with such excellent results, that a permanent cure can be promised in a large number of favourable cases. This statement requires explanation. By a "permanent cure" I mean a cure which will last a lifetime. By "favourable cases" I mean children, young subjects, herniæ of moderate size, where the rings and canal are still present and not stretched and converted into one large direct gap into which the tips of two or three fingers can be easily placed, cases where the patients operated on have sense enough to give the newly repaired structures sufficient rest for their consolidation and where, if they must follow employment or exercise that involves much straining, they will give the parts the support of a truss of light pressure or a belt.¹

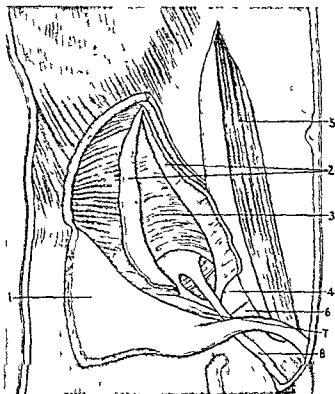


FIG. 15 Dissection of inguinal canal

1. External oblique turned down 2. Internal oblique 3. Transversalis
4. Conjoined tendon 5. Rectus abdominis with its sheath opened
6. Triangular fascia 7. Cremaster 8. Cord

If this is not done we shall see, if cases are carefully followed up and candidly reported, that radical cures will not last a lifetime, and that the term will have to be largely replaced by the following, according to the

¹ *I de infra*. Many will say that if any truss or support is worn afterwards the cure is not radical. I admit this, but reply that until published series of cases have been watched for a much longer period we shall, as relapses may occur five or eight years after operation do wisely to advise the above class of patients to support the restored region with a well fitting truss of light pressure, and so bring about a permanent cure instead of a liability to relapse.

degree of cure obtained, viz. "complete successes," "partial successes," "complete failures."

Since Bassini published, in 1888, the description of his operation, this method, either as first described, or modified in some slight degree, has become more and more popular. W. B. Coley and J. P. Hogue¹ state:

"From December, 1890, to January, 1918, 6,090 operations for the different varieties of hernia have been performed at the Hospital for Ruptured and Crippled. The great majority of these operations were performed by a small group of surgeons—Doctors Bull, Coley, Walker, Downes and Hogue, a small number by the assistant surgeons or house surgeons under our direct supervision.

VARIETIES AND RECURRENCES.

	Cases.	Recurrences	Per cent
Inguinal in the male, oblique	4420	25	·57
Direct hernia, male	33	0	·0
Inguinal in the female, children	690	1	·15
Inguinal in the female, adults	369	13	3·5
Direct hernia, female, adults	13	1	7·7

Nearly all these operations were by the Bassini method or some modification of it.

"In 334 cases the operation was for undescended or maldescended testis. In practically all cases, with three or four exceptions, there was a hernia, either actual or potential, that is, an open funicular sac communicating with the tunica vaginalis.

"It is noteworthy that not a single relapse has been observed in these 334 cases of operation for undescended testis.

"A study of the time of the recurrence, *i.e.* the interval between operation and the time that the recurrent hernia was noted, is of very great interest and importance. In 4,453 cases of inguinal hernia in the male, 25 recurrences were observed, and of these 13 occurred within six months to one year after operation, three within one to two years. The other cases recurred at longer periods after operation: 1 after three and one-half years; 2 after seven years; 2 after three years; 1 after four years; 1 after fourteen years, and 1 after twenty years."

Suppuration is the main cause of relapse; a severe cough is another, especially if present during the first few weeks after the operation.

Schwartz² found eleven recurrences in elderly adults after 207 Bassini operations undertaken during the last ten years. Recurrences in children are very rare. Many failures, about 15 per cent., follow operations for direct inguinal hernia.³

From the above it is clear that, when consulted as to the performance of a radical cure by patients the subjects of hernia, they can be assured as to the safety of the operation and the probable permanence of the cure in favourable cases (*vide supra*). In the practice of experienced and aseptic surgeons the mortality ought not to be more than 0·5 per cent., and the recurrences should be considerably under 5 per cent. Furthermore, it is certain that if a relapse should occur the majority of patients will be

¹ *Ann. of Surgery*, 1918, lxxviii, 255. These figures give a too favourable impression, because it is clear that all the cases were not traced, and a large proportion of the operations were performed on children, in whom the results are far more favourable than in adults.

² *Zent. f. Chir.*, 1922, No. 49, i, 476.

³ J. P. Hogue, *Ann. of Surg.*, 1920, lxxii, 671.

better off than before the operation. The protrusion that appears will be smaller than the original rupture, more readily kept within bounds like a bubonocoele, and a truss will be worn with greater comfort. On the other hand, if *suppuration occur and a thin walled feeble cicatrix, sure to yield increasingly as years go on is the only result* the outcome of the operation may leave the patient worse off than he was before.

A question that often arises relates to the wearing of a truss and the possibility of the hernia being cured by this means alone.

A truss¹ rarely cures a hernia in an adult and knowing this most young patients naturally prefer an operation to the lifelong use of a truss.

When this question whether the wearing of a truss will effect a radical cure arises in the case of infants and children these cases may be divided into the following groups. In one the careful wearing of a truss by a child will permanently cure the rupture. In a second group the hernia though not cured will be perfectly controlled with very slight inconvenience to the patient. In the third there is no tendency to spontaneous cure even when a suitable truss has been diligently worn. Very large herniae and especially those containing the caecum which may be irreducible belong to this class. With the very small mortality of the present day and the few recurrences surgeons attached to children's hospitals operate more and more frequently. It is very difficult to keep the children of the poor supplied with new trusses often enough to render them effectual. If the truss break or be left off and the hernia descend the work of years is undone and strangulation may occur at any time. Again a number of patients supposed to have been cured by trusses in infancy have a return of their trouble in adolescence or early manhood.

Mr Hamilton Russell² even believes that all the oblique inguinal herniae of adults have descended into congenital sacs. We agree with Mr Russell that the large majority of the so called acquired herniae of adults have congenital sacs of the incomplete or funicular type but that most direct inguinal herniae do not protrude into preformed or congenital sacs.

Mr R. W. Murray³ adduces several arguments in support of Mr Russell's views and shows that in 100 autopsies potential hernial sacs were found in 21 cases. 13 sacs occurred in 61 males and 8 sacs in 39 females. In another series of 200 autopsies there were 568 peritoneal diverticula of which 52 were femoral and 13 inguinal. Mr E. W. Roughton⁴ in 18 operations for unilateral inguinal hernia found a potential sac on the other side in 10 cases.

Stiles⁵ gives the results of 360 operations for hernia in infants and young children, with five deaths and only four recurrences.

The Advisability or Need of wearing a Truss afterwards. The tendency of the present day to condemn offhand or to deprecate strongly the use of a truss after an operation for radical cure is, I think a great mistake.

¹ An ill fitting truss is of course worse than useless and may mat together the tissues.

² *Lancet* 1901: 1 and *Brit Journ Surg* 1912: ix 509.

³ *Ibid* 1906: 1 363 1907: 1 298 and *Hernia its Cause and Treatment* 1908 (Messrs J & A Churchill).

⁴ *Lancet* 1911: 1 1534.

⁵ *Brit Med Journ* October 1 1904.

Each case must be judged separately. With regard to children, from an experience of my cases I think that a truss will not be subsequently required, so great is the tendency to repair in early life.

In adults the objection usually made to a truss is that its pressure will produce absorption of the scar and atrophy of muscle. While it will be granted at once that any continuous pressure in the form of a pad with a strong spring will tend to do harm, I am distinctly of opinion that some well-fitting slight support in the form of a flat-bladed truss or belt should be worn in the following cases, viz. where the abdominal walls are very fat, flabby, and pendulous; where there is heavy work either done continuously or by fits and starts; where there is a chronic cough; in some cases where the radical cure has been done after an operation for the relief of strangulation, and the surgeon has perhaps been hurried; and, of course, in cases where there is any return of the hernia. Other cases are some umbilical herniæ, for the reason I have given above; in some cases of femoral hernia in which the crural ring has been very large and difficult to close in stout patients; moreover, the sex and dress of the patient usually make the wearing of a truss less irksome. On the other hand, in early congenital cases, in boys, in young adults without laborious work, or where the reparative power is good, where sufficient rest has been taken after the operation, and where primary union has been secured and remains firm, no truss need be worn. But the importance of intelligent supervision at intervals should be insisted upon. Some surgeons order a truss only when signs of recurrence appear, but it seems wiser to anticipate and prevent recurrence.

The Best Form of Suture. The ideal suture should be aseptic, absorbable, supple, and strong. At the present time it is easy to get catgut fulfilling all these requirements.

Sir William Macewen in his address on Surgery at Oxford¹ discusses the advantages and disadvantages of the various suture materials very fully. He points out that it is not enough to secure an aseptic ligature, but that it is necessary to select one that is absorbed after its work is done in about three weeks. He also draws attention to the important fact that non-absorbable sutures are incapable of *holding living structures together for more than a few weeks*. "After a period of twenty-one days the continued traction of the suture causes the soft tissues to give way before it. And this goes on until the suture lies loose and functionless in their midst." The tissues within the grip of permanent sutures of silk, wire, or salmon-gut become gradually absorbed even without any suppuration, and this clearly leaves the sutured area much weaker than after the use of an absorbable suture like catgut, which does not induce nearly so much of this quiet and aseptic necrosis of the tissues if care be taken not to tie it too tightly.

Macewen strongly condemns the use of wire sutures and relates five cases of inguinal hernia in which gold wire had been employed by other surgeons. Three of these came to Macewen for recurrence of the hernia, and the two others for strangulation of the bowel by the loops of wire, in one of which perforation of the bowel had already occurred at the site of constriction by the wire.

¹ *Lancet*, August 6, 1904. Practically all surgeons agree with Macewen that suitably prepared and sterilised catgut is by far the best material for buried sutures.

Macewen states that kangaroo tendon does not get absorbed for months and Hutchinson has found some of his sutures unabsorbed after two years

Wound Healing—The mortality and the relapses after radical cure of hernia depend more upon the occurrence of suppuration than upon any ~~things else~~ therefore it is of the utmost importance to prevent the slightest suppuration

Indications for Operation—The following are given only as types of appropriate cases. Many others will suggest themselves

(i) Cases of *irreducible hernia* where other treatment has failed where an active life is interfered with or where attacks of inflammation have occurred or strangulation is threatened. Subjects of inguinal hernia with adherent omentum are never really safe especially if of active life from this however they are usually debarred. Femoral hernia containing irreducible omentum should also be operated on. These hernia are difficult to fit with trusses the omentum keeps the ring open and thus paves the way for the descent of bowel on any sudden exertion. Where irreducible hernia are small and the adhesions easily separated great relief will be given the patient with very slight risk. But it is otherwise where the sac is very large or the contents adherent especially about the neck of the sac. In either case the risk of the operation is increased. Intricate adhesions about the neck of the sac may either lead the surgeon to abandon the operation or to lay open the abdominal wall in order to deal with them. This last step may bring about some time later, a hernia very difficult of control the ultimate improvement in the patient's condition being thus of a very limited nature

(ii) Cases of *strangulated hernia* where the patient's condition admits of the operation being prolonged

(iii) Cases where a *hernia is not controlled by a truss* but slips beneath it. Most direct inguinal hernia are easily controlled by a light truss for this type of hernia very rarely descends into the scrotum or becomes strangulated. It is moreover so difficult to cure by operation that a light truss is advisable afterwards if the patient has to work or strain. Therefore it appears to be rarely necessary or worth the patient's while to submit to the dangers and inconveniences of the operation

(iv) Cases of *hernia with ectopia testis* where the fitting of a truss to keep the hernia up and the testicle down fails

(v) Cases where the *hernia can be controlled by a truss but the use of this is irksome* to a patient of active life where he wishes to join the army or navy or where he may as a colonist be far removed from surgical help

(vi) *Children* especially with large hernia where proper attention to the use of a truss cannot be secured or where the persevering use of this has failed and where all such causes as phimosis cough &c have been removed. It is usually wise to recommend operation for all hernia which are still present at two years of age for a truss rarely cures after this and it tends to cause withering of the muscles is irksome and interferes with healthy exercise and games. By this time the parts are better developed and more easily kept aseptic. The sac is more easily dealt with now than later. The presence of any conditions which call for exploration viz hydrocele, adherent omentum the presence of the appendix will also be indications for operation in children. There is very little risk in an opera

tion at the present day. Recurrences after it are very rare in children, and the relief afforded by it is immediate and nearly always final. Unless there is some grave contraindication, irreducible and irretainable inguinal herniæ are best treated by operation, however young the child may be.

(vii) Large herniæ, even colossal, where the patients, unfitted for work of any kind, are a burden to themselves and others¹ and perhaps willing to run great risks; for it cannot be denied that these are grave cases: "the operation usually difficult and prolonged, and the dangers to be met and overcome both numerous and various" (Banks).

(viii) I consider two to thirty years of age the most favourable time, as combining parts easy to handle, the probable absence of any difficult adhesions and good vitality and health. Old age, in the absence of visceral disease or degeneration of the abdominal wall, and apart from the natural expectation of life, is not a contraindication.

OPERATIONS FOR OBLIQUE INGUINAL HERNIA

Before describing the different methods mostly in vogue, I will allude, for the sake of my younger readers, to a few points which are always of importance whichever method is selected.

An ample incision is made over the inguinal canal and extending just below the external abdominal ring. This divides skin and fasciæ, the superficial epigastric and several branches of the external pudic vessels; these should be secured with forceps, which will also open out the wound. All these vessels are tied with fine catgut towards the end of the operation. The aponeurosis of the external oblique is slit up for two and a-half to three inches in the direction of its fibres, care being taken to avoid cutting the ilio-inguinal nerve. The aponeurosis is reflected well back to expose thoroughly the internal oblique muscle and the deep aspect of Poupart's ligament down to the spine of the pubis. The cremasteric fibres are separated along the upper border of the cord, displacing the infundibuliform fascia; this is seized with artery forceps and divided, exposing the thin white tissues of the sac, which is held by artery forceps, and carefully separated from the veins and vas deferens by gauze dissection. It is much easier to isolate its narrow neck than to separate the wide sac lower down. The sac is held up and opened to see if it is empty; if so, it is divided between clamps. The lower part is then rapidly separated by gauze dissection, applied along its posterior surface, and excised; if it opens into the tunica vaginalis it is tied and divided low down. The upper end of the sac is dissected and drawn down until the parietal peritoneum is exposed, transfixed and tied with No. 1 catgut well above the neck of the sac, so that no funnel remains. It is important to expose and separate the sac in a methodical manner, without needless disturbance of the contents or coverings of the cord. Otherwise it is easy to lose the way, to cause needless hæmorrhage, or even to divide the vas, especially in children.

When the sac contains intestine the latter must be completely reduced after separating adhesions if necessary. Omentum is best reduced without damage, unless it is adherent to the sac, inflamed or very bulky, when it

¹ As in three cases given by Sir W. M. Banks; one, a labourer, unfitted for work, had become an inmate of a workhouse; the second was a wine merchant, who had been obliged to give up his business, rarely venturing out, and then obliged to conceal his deformity under a large overcoat; the third, a glass-blower, reduced to perfect helplessness, had to depend on his wife for his support.

is best clamped, transfixed and divided with the greatest care to make sure that all bleeding from the stump is arrested before the latter is reduced.

Hernia with Unusual Contents These may be (i) *Hernia of the ovary*. This is much more commonly met with in inguinal herniae. The chief points in the diagnosis of these difficult cases are the characteristic oval shape and size of the swelling, the peculiar sickening pain when the swelling is pressed upon, the swelling being larger and the tenderness greater during menstruation. When other treatment has failed, when the swelling is irreducible and prevents the fitting of a truss, the displaced ovary should be replaced or removed if necessary.

(ii) *Hernia of vermiform appendix*. I have always removed the appendix.

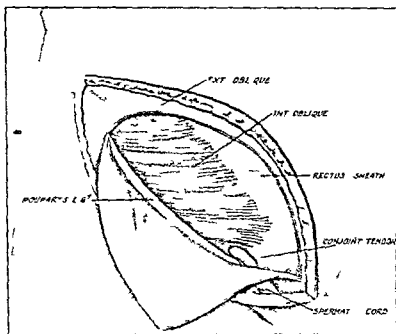


FIG. 10. Normal inguinal canal. The dequelles closely enclose the cord and make the canal long and alveolar.

(iii) *Hernia of the bladder*. The viscus may descend either partly or completely covered by peritoneum. In the first and commonest form the bladder may not be recognised until it is wounded, or even until collapse develops, and hæmaturia is discovered some hours later. I know of two cases in which this accident occurred during the radical cure of femoral hernia, and one of the patients died. The bladder protrudes more frequently into an inguinal hernia.

The canal is now closed by one of the methods given in detail below. The wound having been thoroughly dried out, it is closed with a continuous suture of catgut or fine linen thread, care being taken to avoid inversion of the edges, and of far more importance to tie all divided vessels. Sterilised dressings are applied. In applying the bandages, it is important to support the scrotum and thus to lessen pain and swelling.

To the above general remarks I have only to add that it is always well, when the radical cure is performed in patients with long-standing hernia, for the operator to obtain leave beforehand to sacrifice the testicle; and the same course will be taken when a retained testicle is judged to be functionless.

Choice of Operation. The different methods that have been elaborated are very numerous, and only those which are chiefly in vogue at the present time can be described here in full. Brief mention will, however, be made of some of the others.

(1) **Bassini's Operation** (Fig. 18). The preliminary steps have been described (p. 42).

The cord is separated from its bed and, supported in the loop of a Lane tissue-forceps, is held forward by an assistant while the sutures are intro-

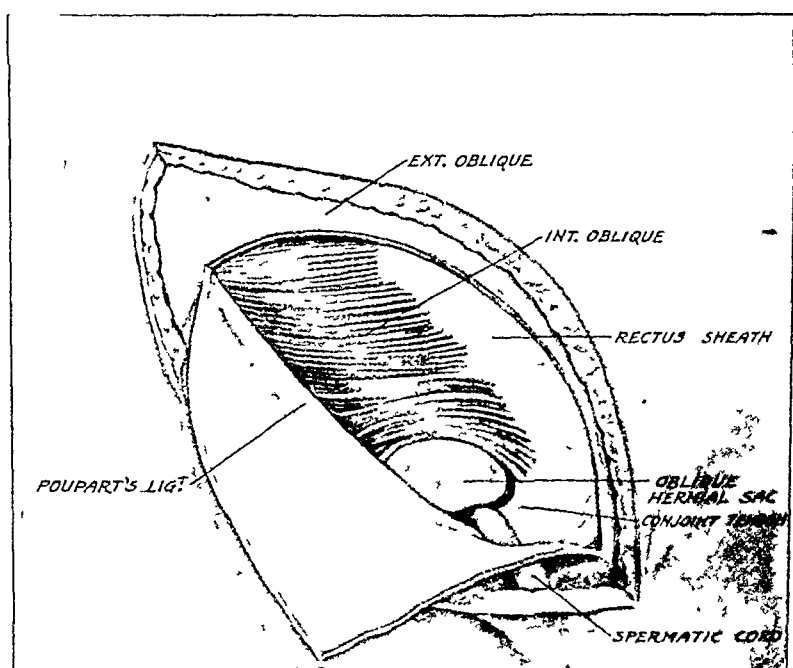


FIG 17 Inguinal canal in hernia The sac displaces the deep muscles and makes the canal more direct and less valvular.

duced. At this stage any lipomata of the cord or an inguinal varicocele may be removed. The posterior wall of the inguinal canal is now repaired by means of sutures. These will vary in number from four to six, according to the size of the gap between the internal oblique or conjoint tendon on the one hand and Poupert's ligament on the other. The needle is first passed through the deep aspect of Poupert's ligament, then back and fore through the cremaster, and finally through the lower margin of the internal oblique or conjoint tendon beneath the uplifted cord (Figs. 19, 20). Coley and Hoguet¹ pass the lower stitch in a special way and regard it as the most important in the whole operation. "The external oblique is reflected inward, and the ilio-inguinal nerve, which up to the present time is held on the inner side by a retractor, is now released and allowed to

¹ *Ann. of Surg.*, 1918, lxxviii, 255.

drop back into its normal place. The reflected portion of the external oblique about one half an inch above where it meets the conjoined tendon, is transfixed with a sharp Hagedorn needle. The needle then crosses over the nerve and picks up the outer portion of the conjoined tendon, crosses over beneath the cord and enters the lower part of Poupart's ligament, close to its attachment to the pubic spine. The tighter this suture is drawn the more room there is for the underlying nerve which can never be compressed. This is essential as a great deal of neuralgic pain which often

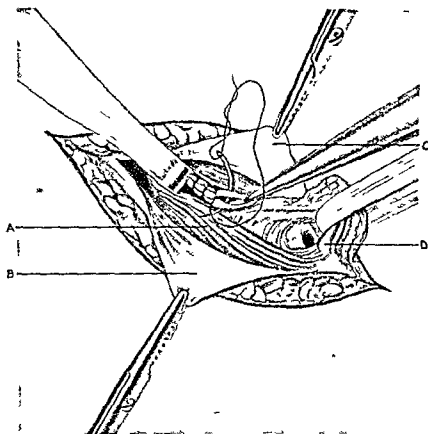


FIG. 18. Scudder's modification of Bassini's operation. Sewing the neck of the sac, a retractor being used to expose it well.

A Large cremaster B External oblique C External oblique D Vas deferens

follows hernia operations is undoubtedly due to this nerve having been caught in the sutures. When this suture is tied the lower portion of the inguinal canal is completely closed. Sufficient sutures having been passed they are tied carefully and cut short and the cord allowed to fall back into its place. The divided edges of the external oblique are now united by means of a fine continuous suture and the external ring if large diminished at the same time. All bleeding having been carefully arrested the skin is sutured and the dressings applied.

Scudder¹ modifies Bassini's operation in several respects

¹ *Ann of Surg* 1905 xli "8

(a) He *sutures* the peritoneum *above* the neck of the sac, instead of ligaturing it (see Fig. 18).

(b) He also places a couple of sutures above and outside the cord to strengthen the attachment of the internal oblique to Poupart's ligament. Bull and Coley also use this improvement to prevent recurrence at this likely spot (see Fig. 20).

(c) Scudder's method of deep suturing is more effective than Bassini's (see Fig 19)

(d) He also overlaps the fibres of the external oblique. I practise

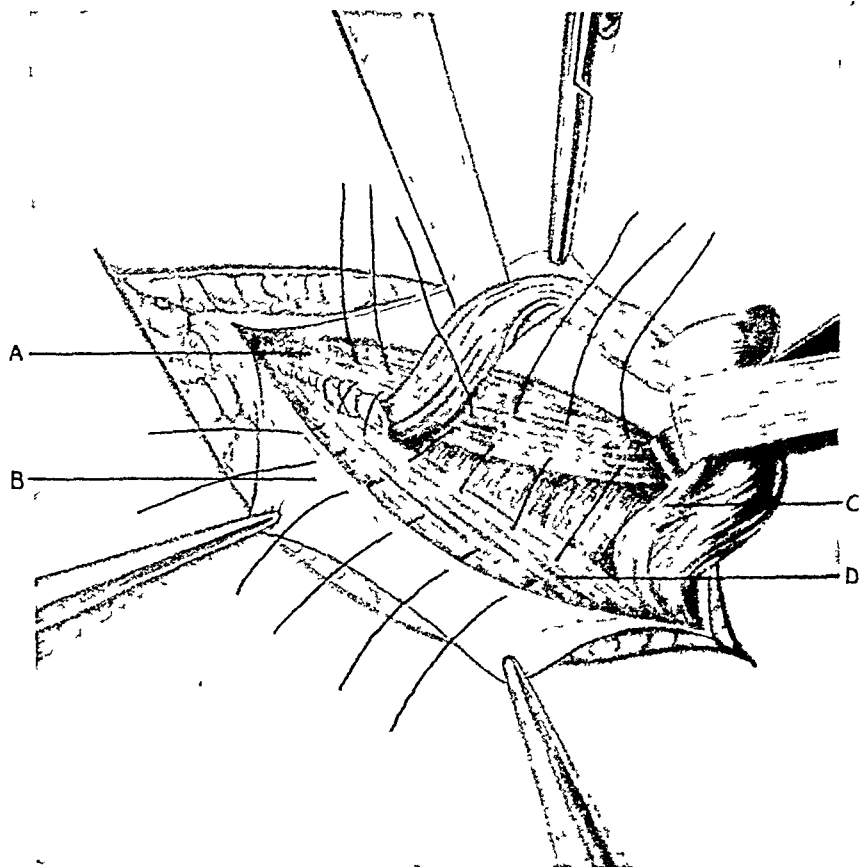


FIG 19 Scudder's modification of Bassini's operation Note method of passing sutures, especially those above and external to the cord

A, Internal oblique B, Poupart's ligament C, cord D, Cremaster

and recommend these modifications except the first, which I only employ for sacs with wide necks.

(2) **Kocher's Operations.**¹ The late Professor Kocher wisely abandoned his earlier method of treating the sac by torsion, and drawing it out through the external oblique aponeurosis, and fixing it as a buttress along the anterior wall of the inguinal canal; the sac often necrosed after being treated in this way.

Kocher later used two simpler and safer methods of dealing with the neck of the sac.

¹ Kocher, *Operative Surgery*, p 192.

The external oblique aponeurosis the external ring and the sac are exposed *but the external oblique is not incised*. The sac is completely isolated and emptied. The next step depends on whether or not the sac can be easily invaginated into itself from below. In the former case¹ the sac is treated by transposition and invagination in the latter² by simple transposition.

A Transposition by Invagination The Transposition Invagination Method (see Figs. 21 to 23) is the most effective. The fundus of the sac is grasped by a pair of curved narrow dressing forceps (with toothed ends

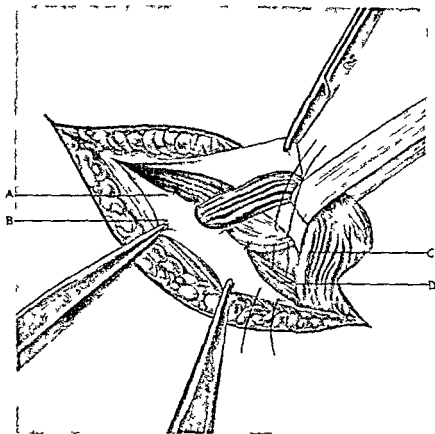


FIG 20 Scudler's modification of Bassini's operation. Sutures above and below the cord tied except two.

A Inguapart ligament B External oblique C Cord D Cremaster

similar to Kocher's artery forceps) and invaginated backwards through the inguinal canal keeping the points of the forceps close behind the anterior wall of the canal and that they are pushed too high up towards the anterior superior spine of the ilium. It is only by a gross mistake of this sort that it is possible to injure the intestine or to nip it between the invaginated sac and the parietal peritoneum.

¹ In an ordinary uncomplicated adult hernia this is practically always possible.

² In children invagination is often difficult as the sac is sometimes very short and thin.

³ The most common mistake is that the forceps are not kept close enough to the anterior wall of the canal and that they are pushed too high up towards the anterior superior spine of the ilium. It is only by a gross mistake of this sort that it is possible to injure the intestine or to nip it between the invaginated sac and the parietal peritoneum.

A small incision is made through the external oblique aponeurosis at this point and the nose of the forceps pushed through, covered by the parietal peritoneum, which is then incised, the edges being caught in artery-forceps. The apex of the sac is now seized with artery-forceps and the curved dressing-forceps are loosened and withdrawn from the canal. The whole length of the inverted sac, the serous surface of which is turned outwards, is forcibly drawn up (Fig 23), its neck transfixed and firmly ligatured at the opening in the aponeurosis and divided, the stump being allowed to slip back. The small opening in the parietal peritoneum and in the aponeurosis is then closed with a stitch and the canal sutured (*vide infra*).

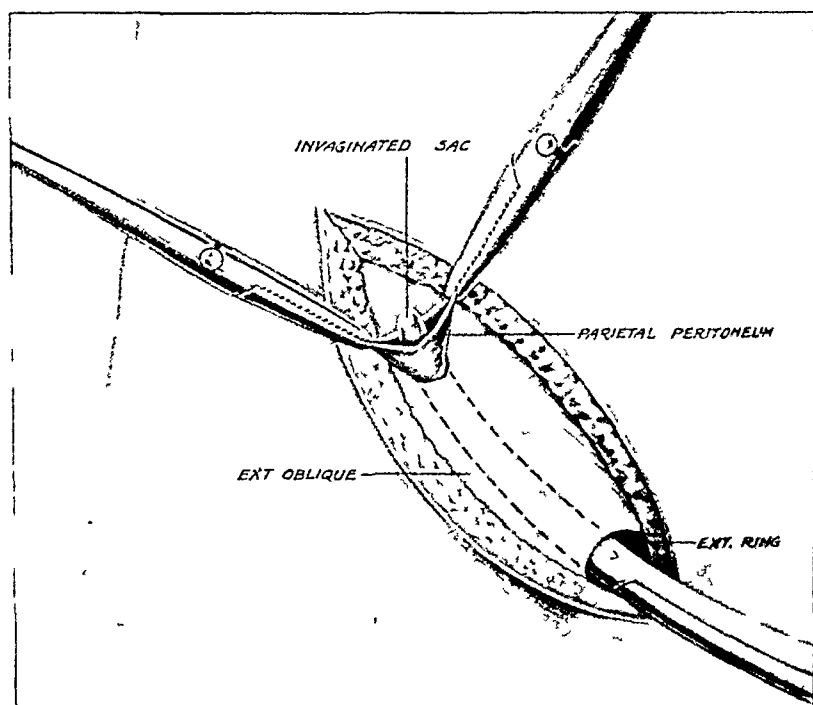


FIG 21 Kocher's method of invaginating the sac and bringing it out through the abdominal muscles (Kocher)

B. Lateral Transposition. When the sac cannot be invaginated either from its shortness, tension or thinness, or because it is advisable to remove it entirely, the apex of the sac is simply grasped with curved forceps and pushed up the inguinal canal immediately behind its anterior wall as far as the internal abdominal ring, where, as described above, it is protruded through a small opening in the aponeurosis and forcibly pulled out (Fig. 24).

As the sac has not been invaginated, the parietal peritoneum in this case is not opened. The neck of the sac is ligatured with strong catgut close to the slit in the aponeurosis, the sac itself is cut off and the stump allowed to retract inside the abdomen. The small opening in the aponeurosis is then closed and finally the canal is sutured.

Narrowing the Canal. The inguinal canal is closed in the following manner: "A series of interrupted sutures is introduced beneath the

aponeurosis of the external oblique where it forms the anterior wall of the inguinal canal, and the portion thus in the grasp of the suture is then depressed with the finger, so that when the sutures are tied two parallel folds are approximated. Two to four sutures are then inserted so as to bring together the pillars of the ring care being taken that when they are tied the circulation in the cord is not interfered with' (Fig 25)

Professor Kocher claimed 97.7 per cent cures in 173 operations by the invagination method and 95.5 per cent in 508 operations by the lateral transposition method. All the cases were observed for five years.

"At autopsies performed at longer or shorter intervals after the operation we have had the opportunity of seeing the results of this procedure

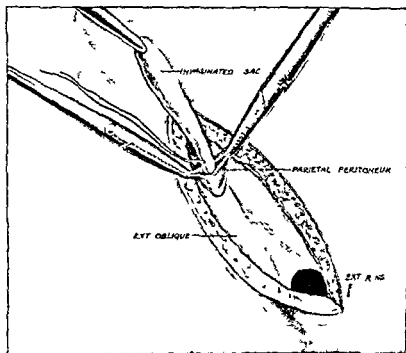


FIG 22 Kocher's method of invaginating the sac and securing the neck to the parietal peritoneum (Kocher)

On the peritoneal aspect at the spot where the sac was drawn through a fine circular peritoneal cicatrix is seen as a prominence with two shallow recesses above and below it. The parietal peritoneum on the mesial aspect is raised in slight folds about 2 to 3 mm in height. There is no sign of any invagination into the inguinal canal.

However perfectly the funnel at the neck of the sac may be obliterated by Kocher's methods, we do not like his way of narrowing the inguinal canal, for the cord is not dislocated outwards or the inguinal canal made more oblique and valvular. We prefer to open the canal to obtain a good view of the parts to be sewn together. We also like to open the sac to make sure that its neck is empty and free of omental adhesions. In females it has been shown that transposition of the comparatively small round ligament is not essential, therefore Kocher's method may be found useful in them, and in some cases of strangulated hernia where time

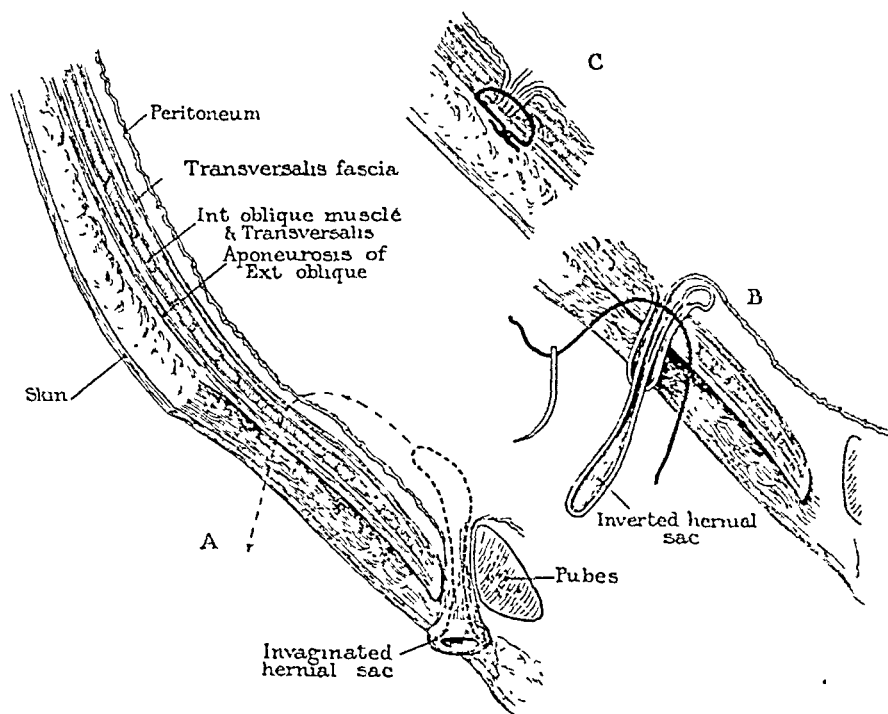


FIG. 23. Sections to illustrate Kocher's method of treating the sac by invagination.

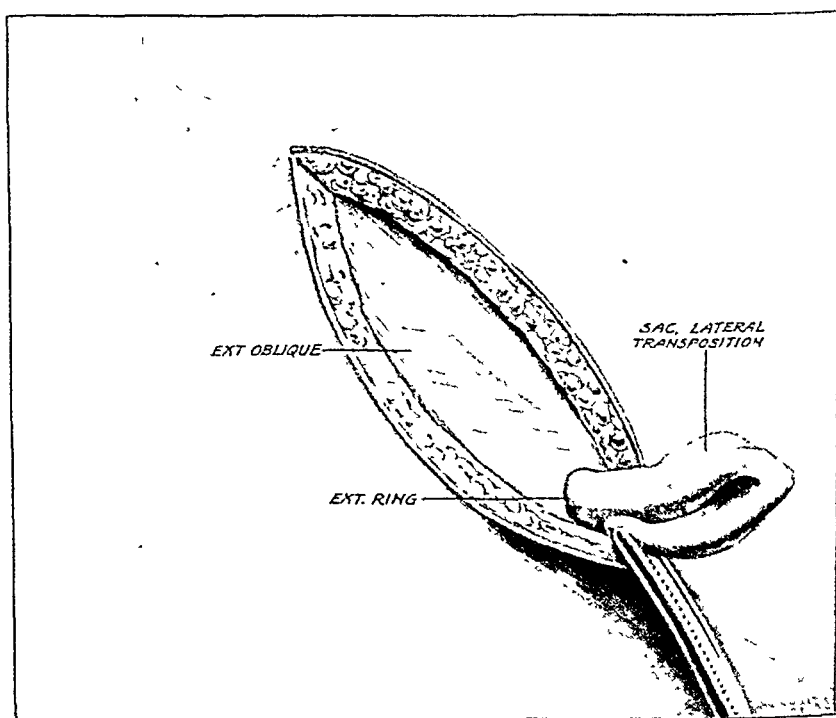


FIG. 24. Kocher's lateral transposition of the sac. (Kocher.)

may be precious, this rapid way of performing a radical cure may be employed with advantage

Kocher's treatment of the sac is not so simple as the high ligation or suture which can be practised when the canal is opened. The thin sacs of children and of some adults cannot be treated by invagination without considerable risk of laceration of the neck.

Very thick inelastic sacs and those with adherent contents are also unsuitable for this operation.

(3) **Halstead's Operation**¹ Halstead's original operation has been very much modified by Halstead and Bloodgood. The inguinal canal is opened as in Bassini's operation and the cremasteric fascia and muscle

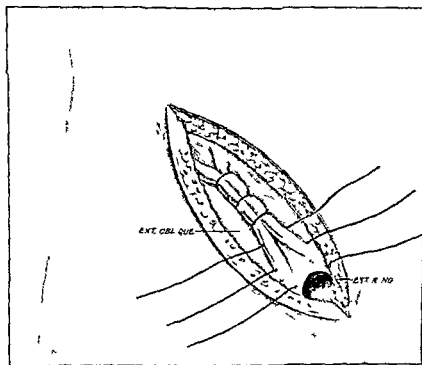


FIG. 90. Kocher's method of narrowing the inguinal canal (Kocher)

are then incised along the superior border of the spermatic cord. The internal oblique muscle and the conjoint tendon of this and the transversalis muscle are thoroughly exposed and defined. The spermatic veins if enlarged as usual are excised care being taken to avoid any extravasation of blood into the loose areolar tissues around the vas deferens and the small veins which accompany it. The vas is not touched or moved lest thrombosis of its veins occur.

The spermatic veins are pulled down, transfixed and tied as high up as possible. Another ligature is similarly applied to these veins just below the external ring and the intervening bundle is excised leaving no large veins in the canal which can therefore be almost completely obliterated by the following steps

¹ *Johns Hopkins B. Met.*, August 1903

The neck of the sac is transfixed and tied as high up as possible, and the ends of the ligature are threaded on long curved needles which are passed deep to the arching fibres of the internal oblique and transversalis, to pierce these muscles at two points one-eighth of an inch apart well above and outside the internal abdominal ring. The ligatures are tied; they serve to displace outwards the neck of the sac and any funnel that may remain above the ligature.¹

The lower flap of cremasteric fascia and muscle is now drawn up deep to the internal oblique and the conjoined tendon, and fixed there by fine interrupted sutures (see Fig. 27, I).

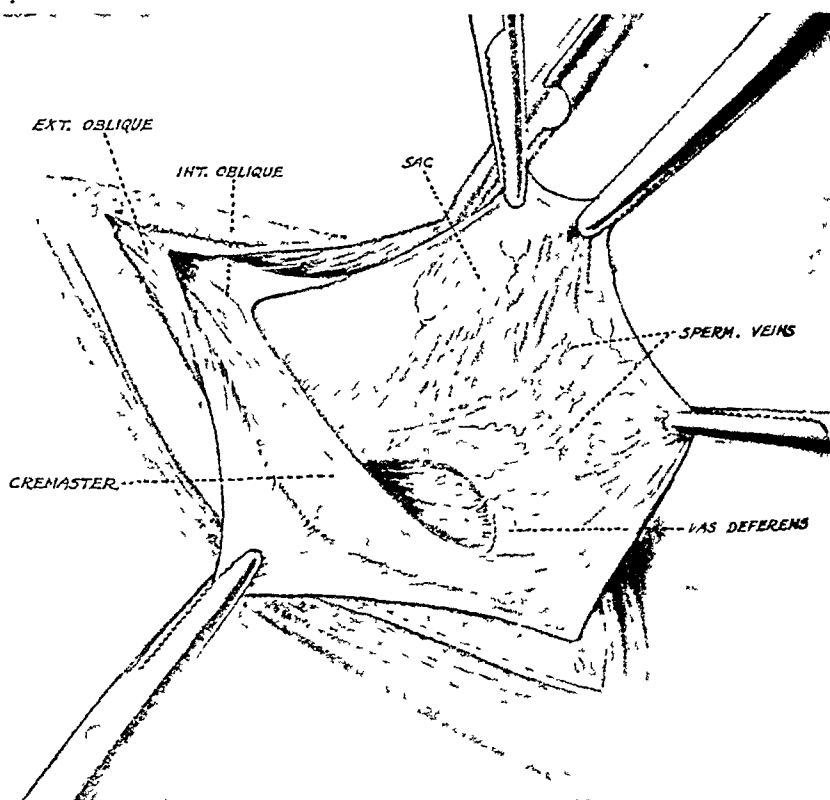


FIG. 26. Halstead's operation. Before the veins and fat have been excised.

The internal oblique muscle and the conjoined tendon are then joined to the deep surface of Poupart's ligament by means of stouter interrupted sutures (see Fig. 28, II).

If necessary the rectus sheath may be incised vertically in order to allow the lower sutures to be tied without undue tension.

This is found very useful when the conjoined tendon is narrow and atrophied. The wound in the external oblique aponeurosis is closed by the Andrews-Halstead overlapping method (see Figs. 29 to 31).

If the hernial orifice is very large a flap of the anterior wall of the rectus sheath may be reflected downwards and outwards and sewn to the deep surface of Poupart's ligament (see Fig. 32); or the outer margin

¹ See Kocher's lateral transposition method.

of the rectus sheath may be slit up to liberate the rectus muscle, which may then be sutured to Poupart's ligament¹

The results of this extensive and elaborate operation are very good as regards the cure of the rupture, and Halstead states that not a single recurrence has been charged to him from 1892 to 1903. The difficulties of following up cases especially unsuccessful ones must not be forgotten however. The writer has performed this operation on many working men since 1905 without yet seeing a recurrence although none of the patients wears a truss. In two early cases hydroceles followed too free

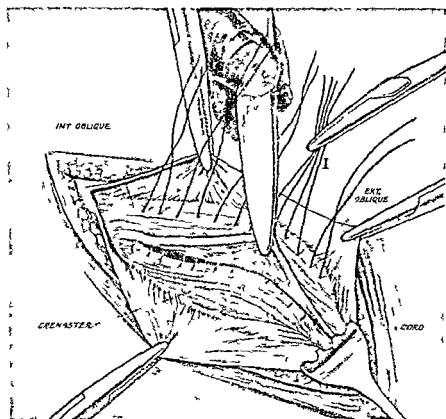


FIG 27 Halstead's operation. Sewing the cremaster deep to the internal oblique

removal of veins, one of these patients came for radical cure for hydrocele two years later.

When it was customary to dislocate the vas deferens atrophy of testis used to follow the operation in 10 per cent of the cases, but since 1899 not a single case of this serious complication has been observed at the Johns Hopkins Hospital although epididymitis and vaginal hydrocele are not uncommon. These can be avoided if one of the veins in front of the vas is left and the testis is well supported by the dressings after the operation.

Halstead's operation in its modern and modified form is no doubt suitable for many cases of large inguinal hernia with large canals and

¹ Bloodgood, *Johns Hopkins Reports*, vol VII and Wölder, *Beitrage z. Fest f. Th. Billroth*

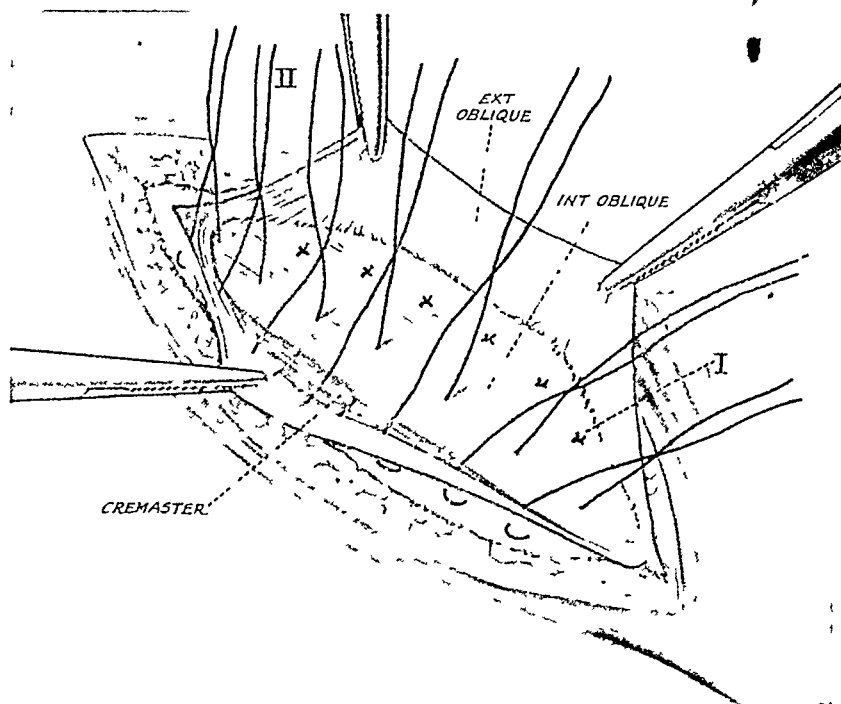


FIG 28. Halstead's operation Sewing the deep muscles to Poupart's ligament.

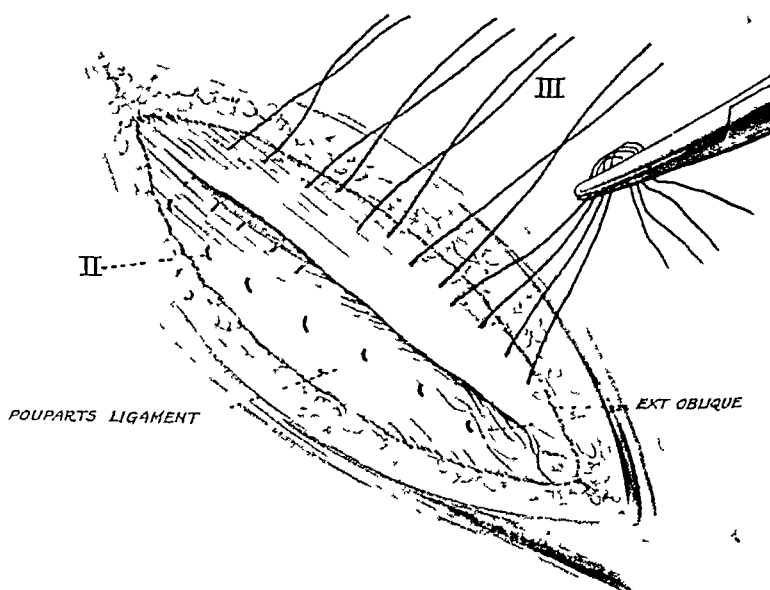


FIG 29 Halstead's operation Overlapping the external oblique

fatty bulky cords. It is particularly applicable when varicocele complicates the hernia. The removal of nearly the whole cord greatly facilitates the radical cure, for "the cord is the first cause of the hernia and the ultimate obstacle to its cure"¹ I do not use nearly so many sutures as Halstead does when performing his operation. For instance, the interrupted suture drawing the cremaster under the internal oblique can also be made to bring the latter down to Poupart's ligament. Again I use a continuous suture for overlapping the edges of the wound in the external oblique instead of interrupted ones.

(4) **Simple Removal of the Sac.** Following Mr Hamilton Russell's work, most surgeons now believe that nearly all inguinal herniæ descend into congenital sacs, and that the removal of the whole sac is the essential

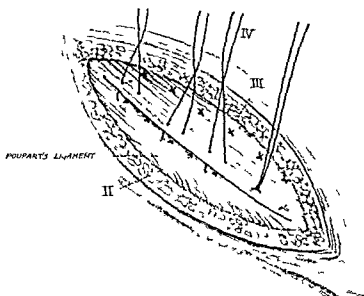


FIG 30 Halstead's operation. Sewing down the edge of the external oblique

part of the operation in young subjects. This should be done without disturbing the normal anatomy of the inguinal canal more than is absolutely necessary.

The following account is taken from Mr Philip Turner's work on hernia.

"The practical bearings of the saccular theory, and the considerations which arise from it on the operative treatment of hernia may be summed up as follows —

"(1) The essential cause of inguinal hernia is the presence of the congenital sac. There is no primary weakness of the abdominal wall which causes the hernia to appear.

"(2) Hence, to cure the hernia, it is essential to remove the sac completely. As there is no primary weakness, there is no need to attempt to strengthen the inguinal canal.

¹ Halstead.

² J & A Churchill 1919.

“(3) The operation should be carried out as soon after the appearance of the hernia as possible, before the development of any secondary weakness.

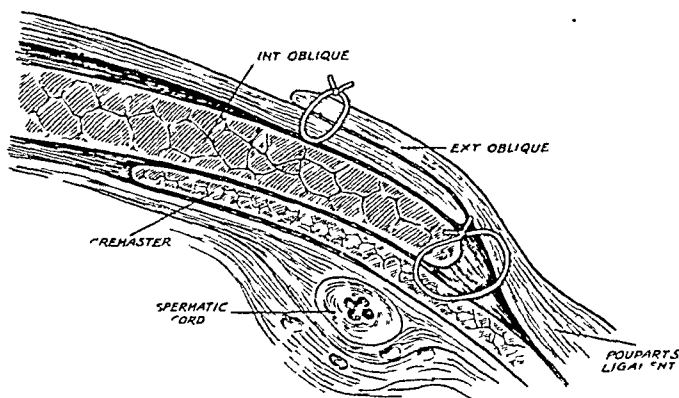


FIG. 31. Halstead's operation. Section to show the overlapping.
(Modified from Halstead.)

“(4) In cases where there is advanced and irrecoverable secondary weakness the sac should be completely removed and an attempt made to strengthen the inguinal canal.

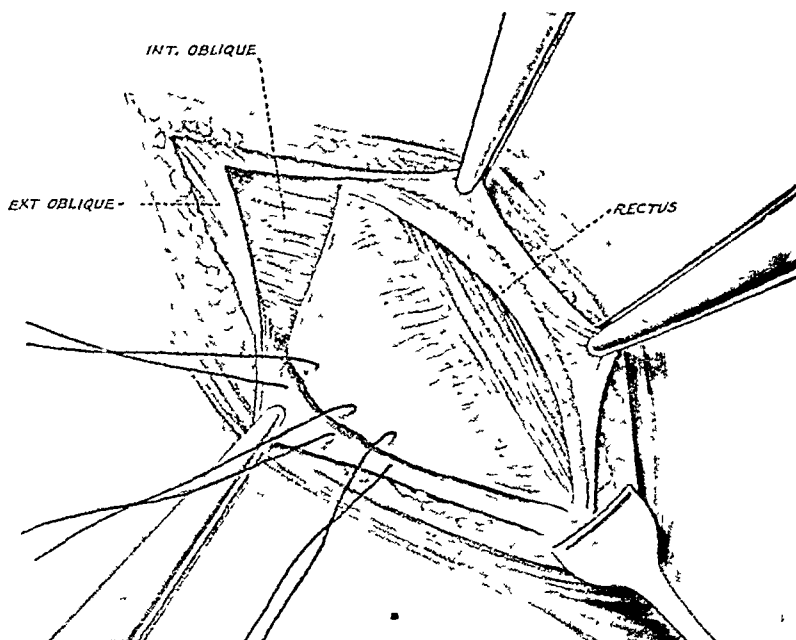


FIG. 32. Halstead and Bloodgood's operation. Turning down a flap of rectus sheath to strengthen the lower and inner part of the canal.

“(5) The operation should, in all cases, be carried out with the least possible damage to the structures entering into the formation of the inguinal canal.

“(6) The external abdominal ring, since it is an important insertion of the external oblique, should not be divided, unless for some reason

this is absolutely necessary for the satisfactory performance of the operation

The operation which will be described in the following pages attempts to carry out these principles. The operation in children and young adults where there is little or no secondary weakness will be first described and subsequently a modification which enables the conjoined tendon to be sutured to Poupert's ligament as in Bassini's operation which is employed in older patients and those where well marked secondary weakness is present. The principle of the method is that the sac is approached from above immediately below the internal abdominal ring instead of dividing the external ring splitting up the external oblique and opening up the inguinal canal as is usually done. Generally speaking this particular operation is applicable between the ages of four and thirty years but each case must be treated on its merits. Especially important is the examination for the presence and extent of any secondary weakness in the manner which has already been described. In infants and young children the inguinal canal is so short and the internal and external abdominal rings are so nearly opposite one another that it is possible to remove the sac satisfactorily by freeing and isolating it after it has emerged from the external ring and then drawing it down and ligaturing it as high as possible. In older children and adults the canal is longer and if this procedure were adopted there would almost certainly be left a funnel shape projection of peritoneum through the internal ring which would probably lead to a recurrence of the hernia.

I first employed the method of completely removing the hernial sac through an incision through the external oblique in the region of the internal ring about twenty years ago. At first I operated in this way in children but have since used it more and more in adults until at the present time except where special indications point to the advisability of some other method I use it or a modification which will also be described as a routine method in all cases. The credit of first suggesting the desirability of approaching the hernia in this way belongs I believe to Mr G. L. Chiene who after I had read a paper on 'The Radical Cure of Inguinal Hernia in Children' before the Royal Society of Medicine Section for the Study of Disease in Children¹ in 1912 drew my attention to a paper of his which I had not previously seen. In this paper² Mr Chiene advocates ligature of the neck of the sac immediately below the internal ring without opening up the inguinal canal. He puts forward the three following principles: (1) That for practical surgical purposes all oblique inguinal hernias are primarily due to the presence of the congenital sac. (2) In young adults the valvular action of the muscles guarding the internal abdominal ring will be regained if the cause of the dilatation of the canal be removed. (3) If the neck of the sac be efficiently dealt with it is quite unnecessary to interfere with the remaining portion in the inguinal canal or the scrotum. While thoroughly in agreement with the first two of Mr Chiene's propositions I am quite unable to accept the third. To leave any part of the sac behind in the inguinal canal would only be to leave an abnormal and useless structure which might become distended with

¹ Philip Turner. The Radical Cure of Inguinal Hernia in Children. *Proc Roy Soc Med* 1912 & Sect on for Study of Disease in Children p. 133.

² G. L. Chiene. Preliminary Note on a Simple Operation for Uncomplicated Hernia in Young Adults. *Brit Med Journ* 1907 i. 1339.

fluid and, in any case, might interfere with the muscles regaining their normal action, or actually be the cause of increased secondary weakness. I can only repeat that I regard complete removal of the sac as the most essential part of the operation. Recurrence has followed simple ligation of the neck of the sac.

“ **The Operation.** (1) *The Skin Incision* (Fig. 33). This is at a slightly higher level, and, hence, further from the groin, than in Bassini's operation. The incision is about three inches in length, and runs parallel to and slightly above Poupart's ligament, ending below, just above the spine of the pubis. Skin and fasciæ are cleanly divided down to the aponeurosis of the external oblique, care being taken not to incise the latter structure at this stage. When any divided vessels have been secured the superficial



FIG. 33.

structures are dissected back, so as to give a good view of the aponeurosis and of Poupart's ligament. The external abdominal ring is not fully exposed, though its upper margin should be identified at the lower angle of the wound, and its size and general condition investigated by inspection and by digital examination.

“(2) *Incising the External Oblique* (Fig. 34).—If the aponeurosis be examined the general direction of its fibres will be found to follow the long axis of the skin wound, though the intercolumnar fibres will be seen and also the interlacing fibres of the intercolumnar ligament. The aponeurosis is not of uniform thickness, and one or more narrow thinner areas, between strong bundles of longitudinal fibres, will nearly always be found

just above Poupart's ligament to the outer side of the external ring. An incision, from three quarters of an inch to one inch in length, should be made in the direction of the longitudinal fibres commencing about a finger's breadth above the centre of Poupart's ligament and extending downwards and inwards in the direction of the external ring. A thinned part of the aponeurosis should be chosen for the incision if possible and in any case the aponeurosis should be split in the direction of its fibres and care should be taken to avoid division of important bundles of intercolumnar or oblique fibres. The lower end of the incision in the aponeurosis will end about half an inch from the margin of the external ring.

"(3) *Exposure of the Spermatic Cord* If the margins of the incision in the external oblique be held apart the fibres of the internal oblique will be seen curving from Poupart's ligament downwards and inwards, to

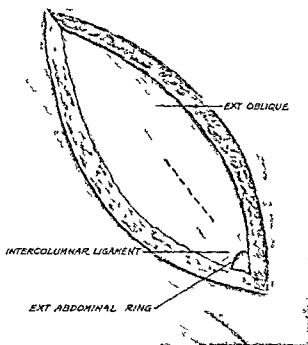


FIG 34

join the conjoined tendon. By means of a blunt dissector the aponeurosis is separated from the internal oblique below as far as the external ring outwards as far as Poupart's ligament, and also to the inner side of the incision, there is no need to separate these structures in an upward direction. The lower border of the internal oblique, just above the external ring will thus be brought into view. A small hook shaped retractor is next introduced through the incision in the aponeurosis and with its help the lower border of the muscle is strongly retracted by an assistant towards the upper end of the wound (Fig 35). If a suitable retractor is not to hand a small aneurysm needle can be employed quite satisfactorily for this purpose. When the internal oblique is retracted the region of the internal ring is exposed, and the cremaster can be seen extending down

from the retracted muscle and covering the spermatic cord. A word of warning is necessary at this stage of the operation. If the hook of the retractor be made to press too deeply, and if it be not introduced quite in the long axis of the inguinal canal, the spermatic cord itself may be displaced inwards, puzzling the operator, and leading to an unnecessary delay, and probably laceration of the muscle, while it is sought for. This is quite easily avoided, and is, indeed, unlikely to occur if only the possibility of the displacement of the cord be borne in mind. With a pair of toothed dissecting forceps and a blunt dissector, the operator now tears through the cremaster, thus bringing into view the spermatic cord enclosed in the infundibuliform fascia just below the internal abdominal ring (Fig. 36).

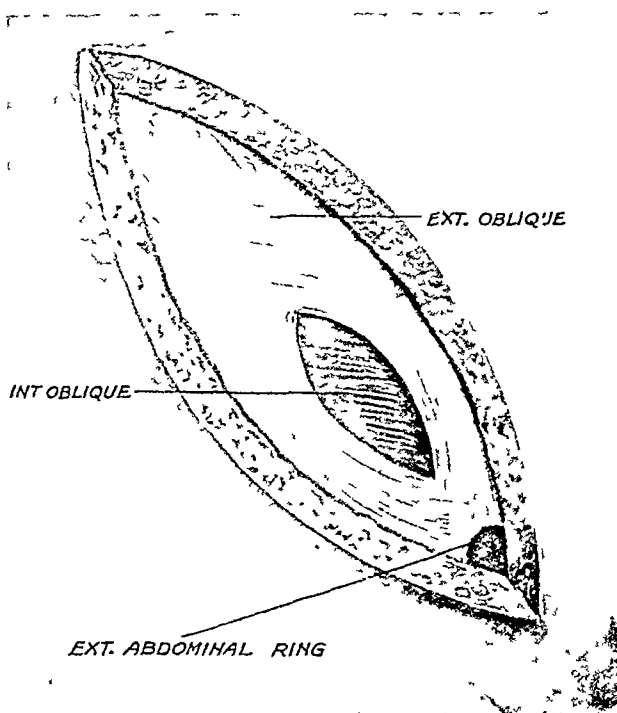


FIG. 35.

"(4) *Isolation of the Spermatic Cord.* The fascial sheath enclosing the spermatic cord and the hernial sac is then seized by dissecting forceps and drawn forwards into the wound. The cremaster is peeled off it, at first in a longitudinal direction and then transversely (Fig. 37). As the cord is gradually freed it is drawn, by traction on the dissecting forceps, more and more through the incision in the aponeurosis until at last it is completely freed behind, when it may be prevented from slipping back into the inguinal canal by passing a pair of Spencer-Wells' forceps behind it. When this has been done retraction of the internal oblique is no longer necessary. The entire manipulation should be carried out as gently as possible. The spermatic cord contains the nerve supply of the testicle, and any undue traction may have an effect on the respiration and pulse in this as well as in other operations for hernia. If the surgeon is careful and the

anæsthetist watchful no harm will result to the patient. This stage of the operation presents no difficulties and is rapidly and easily accomplished.

(a) *Separation and Isolation of the Sac* The fascial covering of the cord is now opened in a longitudinal direction by forceps and blunt dissector. This brings plainly into view the vessels of the spermatic cord and as there should be no injury to the veins and hence no bleeding the white margin of the sac is generally seen at once and is secured by a pair of Spencer Wells forceps (Fig 38). The longitudinal opening in the fascial sheath must be of sufficient length say three quarters of an inch more of the cord being drawn out into the wound if necessary. At this stage of the operation care must be taken not to lacerate the sac itself under the impression that it is only a fascial layer. This is hardly likely to occur in

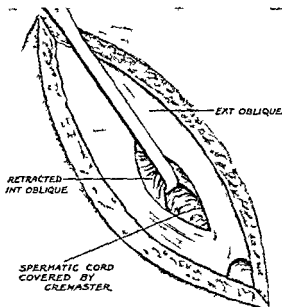


FIG 36

the type of adult patient we are at present considering as the sac will probably be a fairly strong firm and definite structure. Occasionally however in adults and not infrequently in children the sac may be an extremely thin and delicate structure. Under these circumstances the edge may be transparent and indistinct and it may then be accidentally opened. This may be recognised by the smooth shiny appearance of the inner serous lining of the sac and probably also by the escape of a little clear fluid. In doubtful cases too a probe may be passed through the opening into the peritoneal cavity and also along the distal part of the sac towards the scrotum. Should this accident happen the margins of the rent should be secured by a pair of Spencer Wells forceps. Provided that it be recognised at once opening of the sac at this stage is not likely to lead to serious difficulties but if it should escape notice and the sac be

badly torn, the subsequent ligature of the neck of the sac may be a very difficult proceeding.

"The edge of the sac having been secured, the next step is to separate it in a transverse direction from the normal structures of the spermatic cord. A great help at this stage is to keep the various structures well spread out. This may be effected by traction on the edge of the sac on one side and convenient fascial strands on the other, or the left forefinger may be introduced behind the cord and the sac and other constituents be well spread out over this. Transverse separation is effected by gradually peeling away the veins of the spermatic plexus by means of the blunt dissector until the opposite margin of the flattened-out sac is reached (Fig. 38). Isolation and

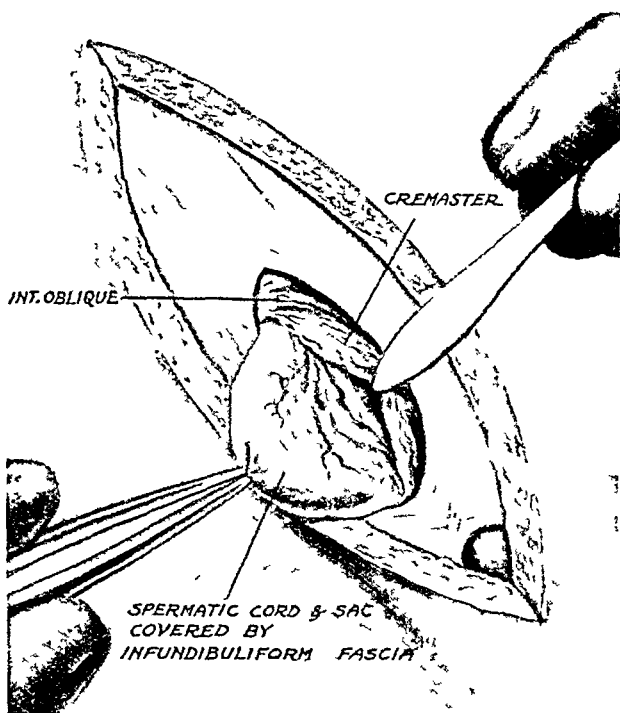


FIG 37

separation of the sac is usually quite easy, the veins generally peel away without difficulty and without any bleeding, and in many cases the sac can be separated without the vas deferens ever coming into view at all. This structure can be readily recognised by its characteristic appearance and feel, and it is well always, after separation of the sac, to recognise its presence in the cord by these means. Occasionally the freeing of the vas from the sac is a matter of some difficulty. It is often much more closely connected with the sac than are the veins. Indeed, sometimes the vas almost projects into the sac, and when this happens with a thin-walled sac laceration can only be avoided by the exercise of great patience and care. Needless to say, the vas must on no account be seized with the forceps. The parts are well stretched out, and the blunt dissector, working longitudinally, is gradually insinuated through the fascia which connects

the two structures. When once the separation has been effected it can be readily extended both in an upward and a downward direction.

The sac is now completely separated from the accompanying structures for a short distance. The lower end is next pulled upon and the separation is continued in a downward direction until the lower end of the sac is reached and freed. This is accomplished by the same means viz by keeping the constituents of the cord and the sac well spread out and by the use of the blunt dissector. The lower part of the sac is likely to be more adherent and sometimes there will be found a solid fibrous cord extending downwards from its lower end which doubtless represents an obliterated portion of the processus vaginalis. The blunt dissector will

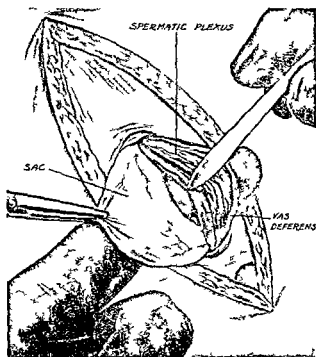


FIG 38

suffice even for the separation of this adherent part and it is as well to avoid the use of any sharp instrument which may be followed by hæmorrhage whereas if the blunt instrument is used any small vessels will be lacerated and will not bleed. Indeed the whole process of separation ought to be a bloodless proceeding. The lower free end of the sac is now secured by forceps and is drawn downwards while the upper end of the sac is freed by dissecting the vas and the veins away in the same manner. The sac must be strongly pulled upon until the extraperitoneal tissue in the region of the internal abdominal ring is distinctly seen and the vas and veins are quite separate from it in this region. The whole sac is now completely free and is ready for removal (Fig 39). There is no difficulty in separating the lower end of the sac even if this extends down to the level of the tunica vaginalis for by traction even the upper end of the tunica vaginalis may be drawn up through the external ring and if this be of

sufficient size, even the testicle may be brought up into the field of operation. It is of interest to note that in these manipulations the external abdominal ring will never be split open, owing to the action of the intercolumnar ligament, though there may be some splitting of the aponeurosis in the opposite direction. It will be well here to repeat that it is necessary during separation that the sac shall be empty. The sac is more difficult to identify, and is much more liable to be lacerated, if it is occupied by a piece of omentum.

“(6) *Removal of the Sac.* If there be any doubt as to whether a piece of omentum or an intestinal coil occupies the neck, the sac should be opened between two pairs of forceps, and the interior inspected or explored

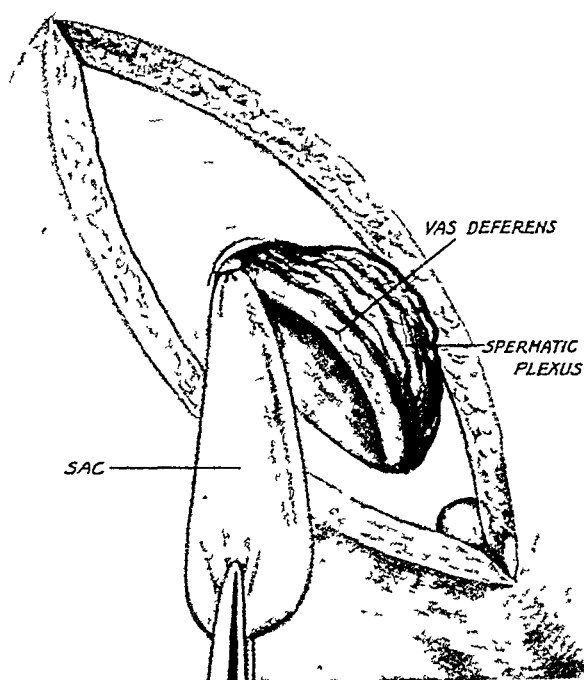


FIG 39.

with the finger. The operator having satisfied himself that there are no contents, the sac is drawn down as much as possible, and is then transfixed and ligatured. A piece of medium catgut threaded on an ordinary curved surgical needle serves for this purpose, and the needle is passed through the sac just above the level where the extraperitoneal tissue is seen. If this is done the sac will be ligatured just above the neck, and is then cut away with scissors. No funnel-shaped projection of the peritoneum into the internal abdominal ring will be left, and the sac will be completely removed. The transfixing ligature is now cut short, and the stump, when released, disappears from view beneath the lower margin of the internal oblique. This muscle now resumes its normal position and covers in the anterior wall of the inguinal canal. The vas and spermatic plexus, with any shreds of fascia, are pushed downwards into the canal with

a blunt instrument, and the field of operation now presents much the same appearance as at the beginning of the operation, viz, the incision in the external oblique with the fibres of the internal oblique crossing almost at right angles beneath it. At one time I used to leave the ends of the transfixion ligatures long after removal of the sac, and afterwards to thread the ends on a needle separately and pass them through the internal oblique above the internal ring. When tied they fixed the stump of the sac at this level, and hence any dimpling of the peritoneum would be at some little distance from the opening in the fascia. As this procedure must have the effect of fixing the internal oblique at this spot and also of

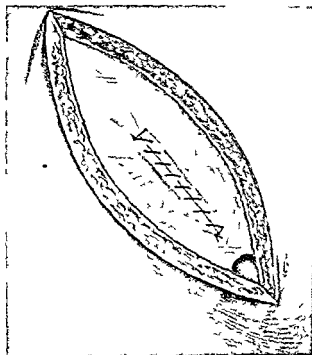


FIG 40

damaging its fibres I have for some time given it up, believing that the free action of the uninjured muscle is of greater importance than the fixation of the stump away from the internal ring.

"(7) *Closure of the Wound* The small incision in the external oblique is now closed with a continuous suture of fine catgut (Fig 40)

"(8) *After treatment* As a rule, the patient is allowed up at the end of a fortnight, and at the end of another week will be able to walk about fairly well. It is advisable, however, that he should not follow any employment calling for severe muscular exertion for another two or three weeks, and the interval may be employed in exercise involving a gradually increasing use of the muscles. No truss is worn during convalescence, or at any time after the operation.

"*The Operation on the Female.* This is carried out on exactly the same lines. The round ligament is much more difficult to separate from the

sac than is the spermatic cord in the male. This is owing to the fact that the sac in the female is much more wrapped round the ligament, and, indeed, the latter is sometimes almost provided with a mesentery. It is thus generally necessary to remove the ligament with the sac, but fortunately this can be done without any after-effects or disability.

“The Operation in Adults when Secondary Weakness is Present. When secondary weakness, as shown by laxity and thinning out of the internal oblique, thinning of the aponeurosis of the external oblique and enlargement of the external ring, is present, provided that the weakness is not excessive and that the age of the patient and the condition of the hernia

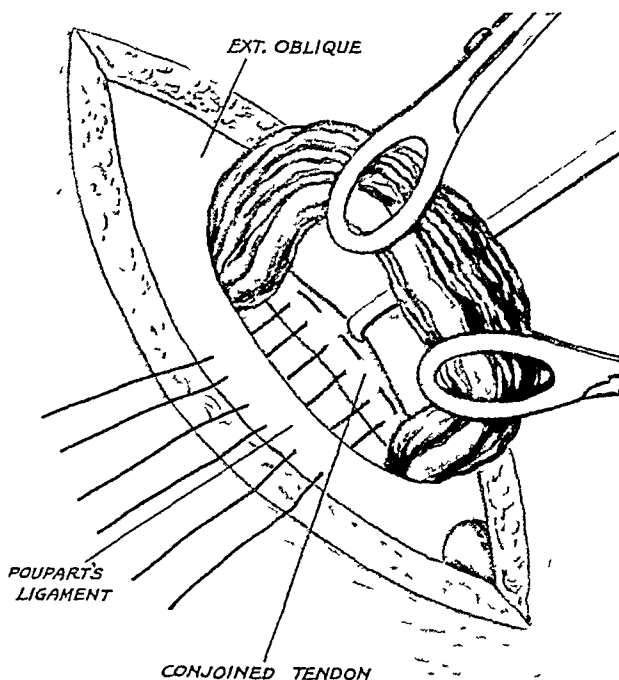


FIG 41

do not contra-indicate it, the following modification of the operation may be tried. It has been pointed out that in such cases the muscles are unlikely to recover their tone and that the weakness must be regarded as permanent. Under these circumstances, suture of the conjoined tendon to Poupart's ligament is unlikely to produce appreciable further weakness, and there is a reasonable prospect that an additional layer of fibrous tissue behind the cord will add to the strength of this part of the inguinal canal. This, however, may be accomplished without dividing the intercolumnar ligament, which, as has been pointed out, is an important safeguard against giving and bulging of the scar and the development of the common form of recurrence after an operation for the cure of hernia. The operation closely follows the lines already described, but the incision in the external oblique is rather longer, and is continued right down to the intercolumnar ligament and a little to the outer side of the external abdominal ring. The actual condition of the internal oblique and the conjoined

tendon are now ascertained by inspection and palpation and it is often as well not to finally decide as to the necessity of suturing the posterior wall of the canal until this has been done. The spermatic cord is exposed the sac isolated and removed in exactly the manner already described. The spermatic cord after removal of the sac is drawn out through the incision in the aponeurosis. Two pairs of Lane's tissue forceps are now made to encircle the whole of the structures which form the cord. These raise and retract the cord at the upper and the lower ends of the wound and in this way a good view of the posterior wall of the canal is obtained (Fig. 41). The conjoint tendon can be distinctly brought into view

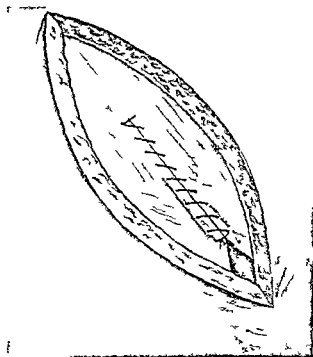


FIG. 40

and a little dissection beneath the outer margin will expose the deep aspect of Poupart's ligament. Two or more mattress sutures can now be passed between these structures behind the spermatic cord and when tied the conjoint tendon is brought down to the ligament across the posterior wall of the canal. The cord is now replaced traction being made on the testicle if necessary for this purpose.

If the aponeurosis of the external oblique is thinned and stretched the margins of the incision may be overlapped.

Another method of strengthening a weakened condition of the aponeurosis is the Darn and Stay lace Method independently suggested by Mr Sampson Handley¹ and Mr Charles Bennett². Though I have no

¹ W. Sampson Handley. The Darn and Stay lace Method for the Radical Cure of Inguinal Hernia. *Practitioner* June 1918.

² Charles Bennett. Inguinal Hernia. *Glasgow Medical Journal* September 1911.

practical experience of this method, it would appear to be of service in these cases.

"If the external abdominal ring is abnormally large, the continuous suture closing the opening in the aponeurosis may be continued downwards, approximating the pillars until the ring is of about the normal size (Fig. 42). In any case the ring must not be so diminished in size by the sutures as to cause any constriction of the vessels of the spermatic cord.

"Advantages of the Operation. The sac is completely removed, and, as the ligature is applied above the level of the neck, there is no protrusion of the stump through the internal ring. The operation is simple, easy and neat, and is rapidly performed. With a little practice, it will be found that the time required for the majority of cases is less than a quarter of an hour. The sac is removed with the minimum amount of injury to, or interference with, the structures which form the inguinal canal; indeed, the sac is exposed by drawing the muscles which form its anterior wall aside rather than by dividing them, for the incision in the external oblique does not open the canal, but enables it to be reached by drawing the internal oblique aside. Since the fibres of the internal oblique do not run in the same direction as those of the aponeurosis but cross at an angle beneath them, these muscles will, when they subsequently contract, pull in different directions, and hence their action may be compared to that of the abdominal muscles after the 'gridiron' incision for appendicectomy. As the sac should be removed without injury to the veins there should be no hæmatoma, and any subsequent thickening of the cord due to hæmorrhage is very unusual. If the inguinal canal be again examined by invaginating the scrotum with the finger during convalescence it will be found that the external ring has sharp and definite margins, and that both it and the canal show little or no evidence of any injury during the operation. This is very different to the feel of these structures after Bassini's operation, where, owing to the amount of scar formation, it is often impossible to identify the various structures. It is this scar tissue which may yield as the result of continued strain and produce a bulging and 'recurrence' in the site of the operation. Another appreciable advantage is that the incision is slightly further from the groin, and hence the possibility of secondary infection of the wound from this region is less. Occasionally, after an operation for hernia, the patient has retention of urine for a day or two, due, I believe, to the extensive dressing which is employed and which often includes scrotum and penis. I have never known retention to occur after this operation, and I attribute this to the simple dressing required and to the fact that it is kept in position by an ordinary spica bandage.

"I have heard it urged as a disadvantage that the operation has to be carried out through a 'keyhole' incision, which does not admit of a satisfactory view and investigation of the parts concerned. This criticism is scarcely justified, for the only stage of the operation which is carried out through the small incision is the exposure and freeing of the spermatic cord. For the separation, isolation and ligature of the sac—the essential part of the operation—as much of the cord as is desired can be drawn out and exposed to view. It is always possible, too, in the event of any unexpected difficulty, to continue the skin incision an inch or two in a downward direction and, by dividing the external ring and opening

the canal, to obtain a free view, and to carry out any other operative procedure which was thought desirable

"Another possible advantage, applying chiefly to cases where there is a slight degree of secondary weakness was pointed out by Sir G Makins. It is that, in the event of failure, the inguinal canal would not have suffered any permanent damage. A recurrent hernia is nearly always an unsatisfactory case to operate upon—possibly because, in the majority of cases some other surgeon has generally performed the original operation—but after the operation described above there would probably be but little scarring and the parts would be in a favourable condition for some further and more extensive procedure

"In conclusion, it may again be pointed out that the operation is intended for favourable cases in children and healthy young adults and not for large hernias where there is great secondary weakness or for hernias in middle aged or elderly people where the muscles are unlikely to regain strength and tone. There is of course every gradation between these groups of cases and it is especially in these doubtful ones that the modification may be employed

"This method should not be employed for cases of strangulated hernia for this is essentially an operation for intestinal obstruction the cure of the hernia being a minor consideration. free exposure of the canal is necessary for the examination and manipulation of the congested and inflamed contents

For similar reasons and also on account of liability of laceration of the sac, it should not be employed for incarcerated or irreducible hernias. The importance of making sure that the sac is empty during the operation in ordinary cases has already been insisted upon

The results of this operation in soldiers on active military service in France were very good showing recurrence in only about 2 per cent of fifty one cases traced for nine months or more of active service involving excessive strain

Operations for Direct Inguinal Hernia I venture to quote from Dr Pierre Hoguet's¹ excellent article in the *Annals of Surgery*. About two years ago, when it was realised that the results of operations on direct hernias were so bad, an endeavour was made to improve upon them by reinforcing the posterior wall of the canal by the use of the aponeurosis of the external oblique, so that there would be in the repair of the hernia three distinct layers instead of two as in the ordinary Bassini operation. But the principle was always borne in mind that the same operation could not be made to fit every patient, so that in some cases the simple Bassini was done in others the Bassini with transplantation of the rectus, and in others the Bassini with the suture of the reduplicated aponeurosis of the external oblique. This operation which was found to be particularly useful in those cases where the internal oblique and transversalis were very weak or where the rectus was very narrow is done as follows. The usual skin incision was made and the aponeurosis of the external oblique split from the external ring upwards in the line of its fibres. As mentioned before an indirect sac always can be found in these cases although it may be very small. This sac is separated from the elements of the cord and opened. It has not been found necessary to divide the deep epigastric

¹ *Ann Surg* 1920 LXXII 672

vessels, but by traction outwards on the indirect sac, all of the peritoneum of the direct sac may be pulled external to the vessels and the two sacs converted into one. By this proceeding, all possibility of injuring the bladder is eliminated, for as the peritoneum of the direct sac is pulled outwards under the epigastrics, if the bladder folds are adherent to the under surface of the sac, they can be clearly seen. This redundant peritoneum of direct and indirect sac is then transfixed with a suture and cut away. The steps up to this point are applicable to all cases of direct hernia, but the actual repair of the deficiency must depend upon the bulk of the internal oblique and transversalis. When the latter muscles are strong, there can be no objection to doing the ordinary Bassini, which will probably give a permanent cure. In the majority of cases of direct hernia, these muscles are weak, and it then becomes necessary to reinforce them. As a double reinforcement, the reduplicated aponeurosis of the external oblique is used in the following way: The upper edge of the aponeurosis is pulled upwards and toward the midline with a sharp retractor, thus making a folded edge of fascia, lying parallel to Poupart's ligament and about one half-inch above the lower border of the internal oblique muscle. The sutures, preferably of kangaroo tendon, are then introduced through this folded edge of aponeurosis, the internal oblique and transversalis, and then through Poupart's ligament from behind forwards, posterior to the cord. It has been found very useful to use a blunt retractor in the lower angle of the wound in order to expose the lowermost portion of the canal, which is essentially the weakest and which should be completely visible when the most internal suture is introduced. One suture should be inserted above the exit of the cord, making a new external pillar to the new internal ring, either in the way described above, or simply through the internal oblique and transversalis, if these are strong enough at this point. The upper leaf of the aponeurosis is then brought over the cord and sutured to the lower leaf, and the skin and subcutaneous tissue then closed.

"The results of operation in 142 cases of direct hernia are given, and it can be seen that the percentage of recurrence from the simple Bassini is 7.3 per cent., from the Bassini with rectus transplantation 2.8 per cent., and from the Bassini with suture of the reduplicated aponeurosis 2.5 per cent."

RADICAL CURE OF FEMORAL HERNIA

There is less necessity for operative interference here, women, in whom the above variety is so much more frequent, finding a truss more efficient and less irksome, owing to their less active life and their mode of dress. On the other side, it must not be forgotten that strangulation is proportionately more frequent, more often overlooked and more fatal in femoral than in inguinal hernia. In omental hernia, where there is difficulty in fitting or unwillingness to wear a truss, in irreducible hernia and in all cases of strangulated hernia, where the patient's condition and the surroundings of the operator admit of it, an attempt should be made to cure the hernia permanently. We are met here by a difficulty less present in inguinal hernia, *i.e.*, that of closing the canal satisfactorily, owing to the rigidity of some of its immediate surroundings and the importance of others.

opening made in the whole thickness of the abdominal wall above Poupart's ligament, and its stump fixed there by suture.

(iii) The ends of the ligature, which have been left long around the neck of the sac, are carried up the femoral canal by means of long curved needles in front of the peritoneum and through the external oblique aponeurosis above Poupart's ligament, about half an inch apart. When these are tied the neck of the sac and any funnel that may remain above the ligature will be drawn away from the region of the femoral ring. While the above ligatures are being passed one assistant should protect the femoral vein, while another draws up the upper angle of the skin incision so that the needles may emerge in the wound.

(iv) The sac, having been isolated below Poupart's ligament, may be drawn upwards through the femoral canal into a wound made by slitting the fibres of the external oblique muscle; its neck can then be tied higher up than by mere separation and traction from below (*vide* Lotheissen's Operation).

B. Closure of the Femoral Canal. The other cardinal step in the radical cure of femoral hernia—closure of the femoral canal and ring—is much more difficult here, for reasons given above.

(1) *Bassini's Method.* After high ligation and removal of the sac, the canal is closed in the following manner: Three sutures are passed through Poupart's ligament and the pectineal fascia. These are left untied, while three or four more sutures are inserted and tied. These unite the falciform ligament to the pectineal fascia, the lowest being placed close to the saphenous vein. Bassini has published fifty-four cases operated upon by this method, without any recurrence in forty-one cases, traced from one to nine years.

(2) *Lockwood's Method*¹ (Figs. 44 and 45). The stump of the sac is first drawn up and fixed as above described. The subsequent steps are described by the author as follows: "For this purpose the index finger of the left hand is pushed up the femoral canal so that it lies with its dorsum against the common femoral vein, and its tip upon and a little within the ilio-pectineal ridge. The finger is intended to protect the vein from the point of the herniotomy-needle, and to guide the latter as its point is thrust beneath Cooper's ligament (*see* Fig. 44). In cases in which the femoral canal has been distended and stretched the needle can be guided by vision. The herniotomy-needle is passed in the following manner: Having been armed with about one and a-half feet of No. 4 or 5 twisted silk,² its point is guided up the femoral canal until it rests against the inside of the linea ilio-pectinea, opposite the outer edge of Gimbernat's ligament. The needle is then rotated so that its point scrapes over the linea ilio-pectinea and picks up Cooper's ligament. Finally, the point emerges through the upper part of the pectineal fascia, where it is unthreaded and withdrawn, leaving the suture beneath Cooper's ligament (*see* Fig. 45). Additional sutures are passed in exactly the same way, but each a little farther outwards, until the last lies at the inner edge of the common femoral vein. Two or three sutures generally suffice, but I have used as many as five. The next step is to thread again the upper end of each ligature

¹ *Hernia, Hydrocele, and Varicocele*, p. 192.

² Catgut is better.

in turn through the herniotomy needle and by pushing the point of the needle half way up the femoral canal and rotating it forwards pass the thread from within outwards through Hey's ligament close to its junction with Poupart's ligament (see Fig 44) Before knotting these threads they are pulled tight to see whether enough have been passed to make a thorough and firm closure of the femoral canal but without compressing the femoral vein (see Fig 45) The final results of Mr Lockwood's cases are not fully given owing to the difficulty in following them up Ten cases however are mentioned. In nine of these the result was satisfactory after periods varying from one to seven years the tenth case relapsed suddenly at the end of six months

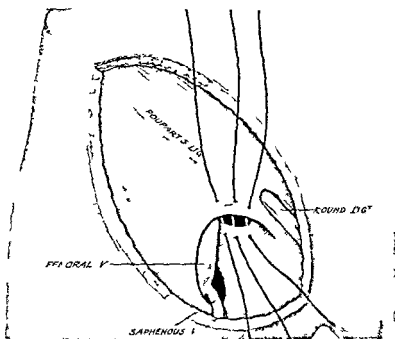


FIG 44 Lockwood's operation Showing the mode of suturing the femoral ring

Kocher's method differs very little from the above he sews Poupart's ligament down to the ligament of Cooper and the pectineal fascia and muscle

(3) *The Purse-string Method of Cushing and Curtis* adopted by Coley¹

After high ligation of the sac and removal of all subperitoneal fat from the femoral canal Coley closes the latter high up with a purse string suture of kangaroo tendon This stitch is introduced with a curved Hagedorn needle through Poupart's ligament near its inner end then through the pectineus fascia and muscle outward through the fascia lata overlying the femoral veins and forwards through Poupart's ligament about a quarter of an inch from the point of entry

This operation is very simple and can be performed quickly hence it is especially useful in critical cases of strangulated hernia

¹ *Ann. of Surg* 1903 xxxv 801

Coley¹ publishes 50 cases with no recurrence, also 16 operations by Bassini's method, with one relapse in a patient whose wound had suppurated. Of these 66 cases, 46 were traced for from one to ten years, and 34 from two to ten years. The chief objections to this operation are that it is difficult to retain such rigid structures as surround the femoral canal by a purse-string suture, and that the femoral vein is especially liable to be wounded.

(4) *Lotheissen's Operation*² (Fig. 46). An incision is made half an inch above and parallel to the inner half of Poupart's ligament, separating the fibres of the external oblique aponeurosis.

The edges of this incision are retracted and the neck of the sac exposed

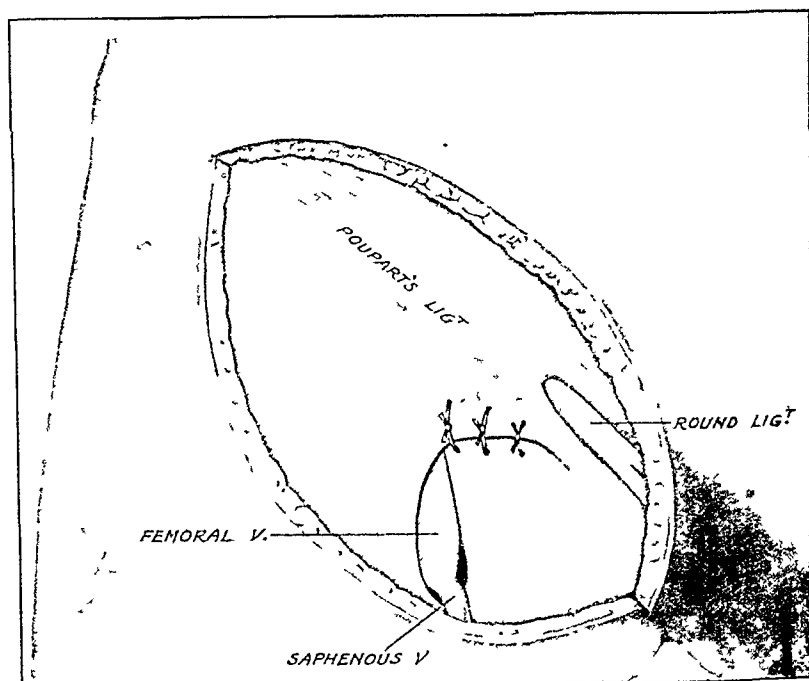


FIG. 45. Lockwood's operation. Showing the closure of the femoral ring completed

and isolated just above the femoral ring and below the curved margin of the internal oblique and conjoined tendon. The empty sac can generally be drawn upwards into the wound, but with large and irreducible herniæ this is not possible; in them the lower border of the cutaneous wound is freed and retracted sufficiently to expose the sac at the saphenous opening in the usual way. The sac is opened and emptied, and its ligated stump is drawn upwards through the femoral canal into the wound in the external oblique. The neck of the sac is then easily tied so high that no funnel can remain above the ligature.

The essential part of the operation, however, is the closure of the upper end of the femoral canal by joining the lower margins of the internal oblique and transversalis to Cooper's ligament.

¹ *Loc. supra cit*

² *Centralblatt für Chirurgie*, 1898.

Sutures of catgut are passed by means of curved round needles (*see* Fig 47) first through the mobile muscular arch and then under Cooper's ligament, which is fixed. The first suture should be passed close to Gimbernat's ligament and the last near the femoral vein the point of the needle being guided by the finger (introduced through the saphenous

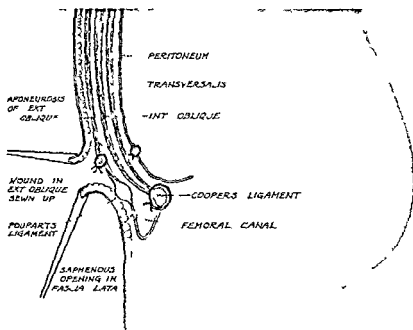


FIG 46 Diagrammatic section to illustrate Lotheissen's operation for femoral hernia

opening) which should also carefully protect the femoral vein. Three sutures are generally enough. Care must be taken not to wound or compress the vein with the last suture. In males the conjoint tendon is secured to Cooper's ligament behind the spermatic cord which is held out of the way.

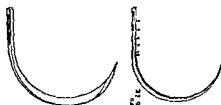


FIG 47 Symonds' needles

The wound in the external oblique is now closed by a continuous catgut suture. The writer overlaps the edges of this wound to give greater support. Two years later Gordon described an operation almost identical with the above.¹

This seems to me to be the operation which most closely approaches the anatomical ideal, for the canal is closed at its upper end instead of

¹ *Brit Med Journ*, 1900 : 1338

lower down, as in all the older operations, and the sac can be tied at a higher plane. In practice it is not very difficult to perform, if only suitable needles be employed. An oblique skin incision starting above the centre of Poupart's ligament and extending downwards and inwards over the saphenous opening is more generally useful than the horizontal one; and this is especially true for irreducible and strangulated herniæ, in which the sac has to be isolated and emptied from below Poupart's ligament.¹ The writer has used this method for the majority of his cases of both ordinary and strangulated hernia during the last twenty years with excellent results.

The operation is not easy in very stout patients; the conjoined tendon and internal oblique muscle are then fatty and difficult to define in a deep wound.

RADICAL CURE OF UMBILICAL HERNIA

This operation is very rarely called for in children, in whom the tendency to natural cure is very great. In adults the patients usually met with—stout women of middle age, with damaged viscera, bronchitis, &c.—are not very good subjects for operative interference. Formerly the results of the operation were so bad that the name of "radical cure" could hardly be given to it.

Winslow² states that formerly 50 to 75 per cent. of relapses occurred in the cases of large umbilical herniæ, even in the practice of the best operators; and that 50 per cent. of the strangulated cases died.

The recent improvements in the methods of operating and the consequent amendment of the results justify a more frequent use of the operation with the object of preventing strangulation, which is attended with such fatal results in this form of rupture. It is also very important to operate early, while the protrusion is still small, for the prognosis of the operation varies almost inversely with the size of the hernia. Busse found that 75 per cent. of recurrences occurred in the cases of large herniæ, 50 per cent. in the medium-sized, and none in the small ones (from the size of a hazel nut to that of a walnut).

Suppuration had not occurred in any of these cases.

A radical cure may be performed—

- (a) After the operation for relief of strangulation in suitable cases.
- (b) In those rare cases of infantile hernia where the wearing of a suitable truss has not been sufficient.

(c) In congenital hernia of the new-born child. In these cases, either herniæ into the root of the cord or (from deficiency of the abdominal walls) partial eventrations, interference is often out of the question from the co-existence of other malformations. If the hernia be uncomplicated and the child appear likely to survive otherwise, an attempt should be made by abdominal section to return the contents, refresh the edges of the opening and unite them with sutures. Mr. W. H. Ogilvie showed a very successful case of this kind before the Royal Society of Medicine in 1921.

¹ See p. 22.

² *Ann. of Surg.*, 1904, xxxix, 245.

(d) In most cases of small and medium-sized hernia in the adult unless the rupture is easily retained by means of a truss or a belt, granted that the patient's general health is good enough to enable her to bear the operation and the subsequent rest in bed

It should be the surgeon's aim to prevent as far as possible, (1) the development of strangulation, and (2) the growth of those large inflamed and often inoperable herniæ which are to be seen far too frequently. Earlier operation in suitable cases will do much to avoid these serious complications

Operations The old operation in which after dealing with the sac, the fibrous edges of the ring were sutured together is to be strongly condemned because the tension on the stitches is so great that the latter may give way or tear out and lead to an early reappearance of the hernia and strangulation or to a more certain recurrence later

(1) *Simple Suture of Separate Layers* In small hernia, and especially in the infantile variety, a simple method is to explore the hernia and reduce the contents and then after excising the sac and its coverings, to incise the fibrous edges of the ring so as to expose the margin of each rectus muscle. The wound is then closed by separate layers of sutures, one for the peritoneum and the deep layer of the rectus sheath, one for the muscles and the anterior layer of the sheath and one for the skin. The objection to this method is that the wound is a direct and not a valvular one and that this makes a recurrence likely if the abdominal tension be much increased later

(2) *The Lateral Overlapping Method* In these cases it is clearly better to suture the various layers in the overlapping manner so strongly recommended by Winslow¹

Winslow quote Coley to the effect that Bull and Coley had twelve relapses after simple suture of separate layers in twenty one cases of ventral and umbilical hernia

In the majority of cases however the hernia is large its coverings thin and the recti widely separated and atrophied. In these it is generally impossible to keep the muscles and aponeuroses together by simple suture without undue tension on the stitches which may tear out and lead to an early and sometime a disastrous return of the rupture. For the same reasons Winslow's method of suture is impracticable. For these cases one of the flap methods is suitable and Mayo's operation is by far the simplest and the best. It is based on the fact that in the subjects of umbilical hernia the abdominal wall is too long and pendulous in a vertical direction so that it is far easier to overlap from above downwards than from side to side

(3) *Mayo's Operation* An elliptical incision is made in a transverse direction around the hernia near its base and the aponeurosis of the external oblique is thoroughly exposed for a distance of $2\frac{1}{2}$ in. to 3 in. around the margin of the hernial aperture. The fibrous and peritoneal coverings are divided all round the very neck of the rupture, and the hernial contents are easily examined here because there are rarely any adhesions at the neck

¹ Ann of Surg 1904 xxxix 945

² Journ Amer Med Assoc July 25 1903 Piccolo and Sapejko have also described the operation (Centralblatt für Chirurgie 1900 p 36)

If the intestine be adherent within the body of the sac, these adhesions can be more easily and safely separated by working forward along the free bowel found at the neck. This is reduced, and the omentum ligatured at the hernial orifice. The sac with its thin and adherent coverings and omental contents are then rapidly removed in one mass without any of the troublesome and tedious dissection which is usually necessary when the sac is opened at its fundus (*see* Fig. 48).

The hernial orifice is examined, its long axis is generally transverse, and its edges are more easily approximated by traction on its superior

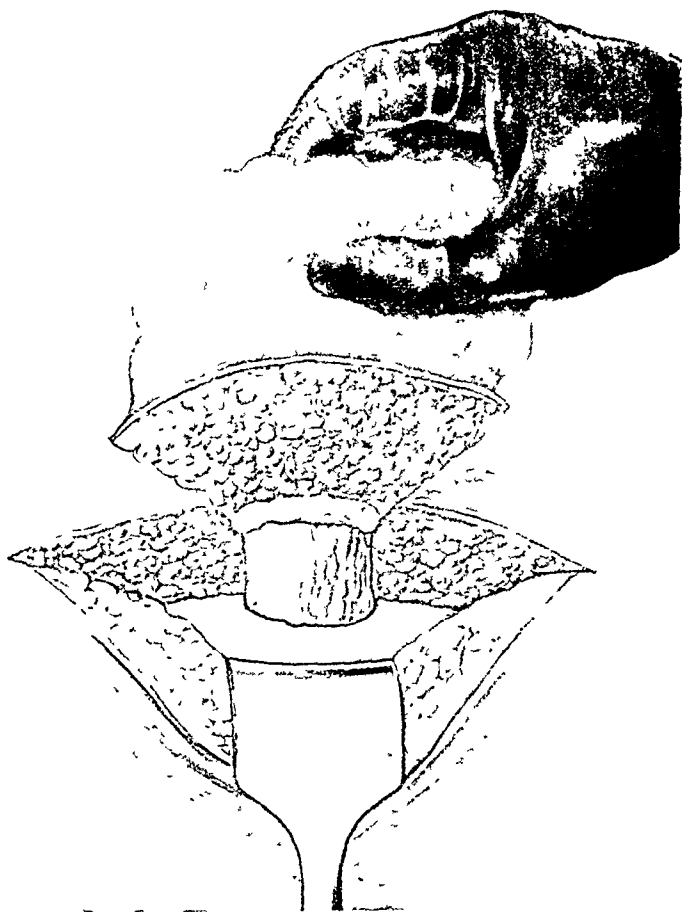


FIG. 48. Mayo's operation for umbilical hernia. A transverse elliptical incision has been made to expose aponeurosis and neck of sac. (*Annals of Surg.*)

and inferior edges. The aponeurotic ring is widened by making two transverse incisions from its lateral poles, each extending for an inch or more outwards, thus making superior and inferior aponeurotic flaps. The peritoneum is now separated from the deep surface of the upper flap, and the lower flap is drawn up behind the upper one by means of strong mattress sutures. Before these sutures are tied traction is made upon them to allow the peritoneum to be closed by a continuous catgut suture.

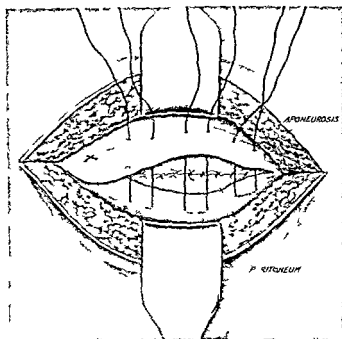


FIG. 49 Mayo's operation. Aponeurosis sutured in an overlapping way with mattress sutures.

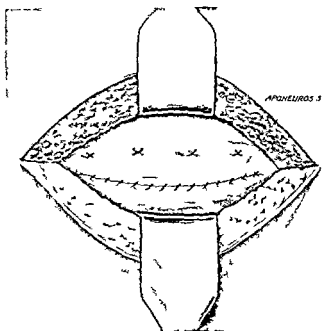


FIG. 50 Mayo's operation for umbilical hernia. Mattress sutures tied. Continuous suture holding down edge of flap.

The mattress sutures are tied, and the lower edge of the upper flap is sewn to the front of the base of the lower one (see Figs. 49 and 50).

In some cases lateral flaps may be more easily obtained, and should then be employed.

Mayo reported thirty-five cases of umbilical hernia operated on by his method, with only one slight recurrence in one of the ten cases in which he had used lateral flaps. The writer has used this method extensively during the last twenty years and has found it very satisfactory in its immediate and permanent results.

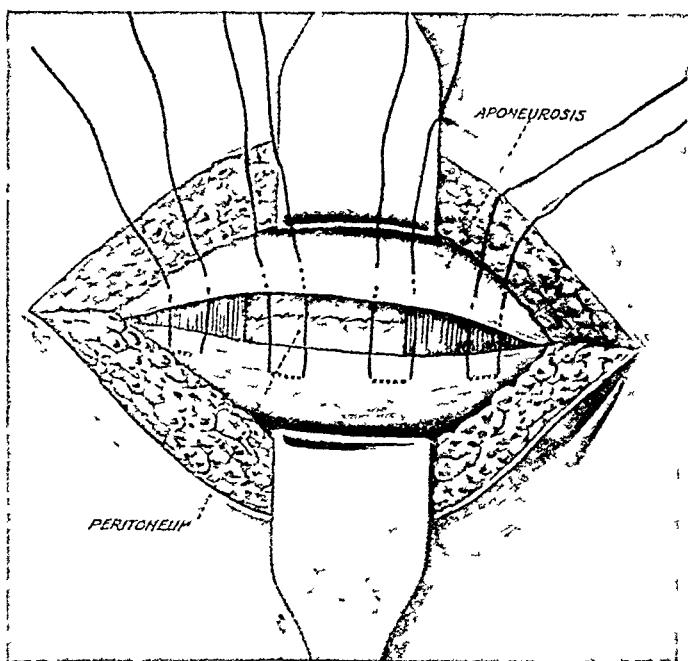


FIG 51 Kelly's modification of Mayo's method The recti are not divided, only the anterior aponeurosis is overlapped

Kelly overlaps only the anterior walls of the rectus sheaths from above down, otherwise his operation is like that of Mayo. It is suitable for small umbilical herniæ when the muscles are fairly good.

Noble, Ferguson and others have used flaps of the anterior wall of the rectus sheath to close the hernial orifice, the base of each lateral flap being at the margin of the ring; the flaps are then rotated inwards and sutured together, so that the surfaces formerly anterior now become posterior. I often use this excellent method.

(4) *The Implantation of Silver Wire Netting or Filigree* For very large umbilical and ventral herniæ this method has been strongly recommended by Witzel,¹ Phelps, Willy Meyer, Gopel,² Bartlett, and McGavin.

For such cases formerly considered incurable, yet greatly in need of surgical aid this operation may be tried if the patient's general health be good enough, and the coverings of the rupture can be rendered aseptic,

¹ *Centralblatt für Chirurgie*, 1900, pp. 257, 459, and 1149

² *Ibid*, p. 458.

A properly fitting and elastic belt should, however, be always well tried first and in the majority of cases will be found sufficient Winslow's remarks¹ upon this subject, although somewhat too pessimistic, are well worthy of remembrance, and may be quoted in full "Such a mode of support [wire netting] has of course no anatomical basis, and

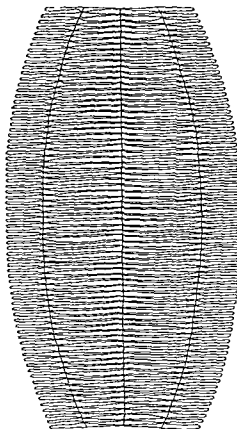


FIG 59 McGavin's wire filgree

but limited surgical application, though of undoubted value in those exceptional cases in which it is unfortunately appropriate. It does not appear to be appropriate as a routine treatment of hernia. Since acting as a foreign body the silver wire tends to set up suppuration and sinus formation which weaken the wound and defeat the very object for which the wire netting is used. The indication for the netting is to reinforce the abdominal wall in cases where owing to thinning out of stretched structures entering into the hernial orifices or to removal of diseased tissue normal approximation of the abdominal wall cannot be secured.

The writer does not use any form of wire filgree believing that living flaps are better in every way.

Operation The sac and its contents having been dealt with the layers of the abdominal wall around the ring are dissected apart. The peritoneum and

the posterior wall of the rectus sheath are separated from the deep surface of the muscles for several inches and then sutured by a continuous wire suture. A silver filgree one and a half times as long as the hernial aperture and $1\frac{1}{2}$ in broader is then inserted between the recti and their posterior coverings and secured in position by a few sutures which pass round the longitudinal wire and through the rectus sheath. No attempt is made to fix the ends of the loops, for Bartlett has proved that this is unnecessary and damaging to the tissues. The loops become well secured by the granulation tissue that forms within and around them. The edges of the muscles and their fascial coverings are then drawn together as much as possible by mattress wire sutures and if considered necessary another filgree may be implanted over the anterior sheaths of the recti, and the skin and fascia united over it.

Bartlett makes a silver netting to suit each case by twisting silver wire (gauge 27) round the ends of nails driven through a board. It is

¹ *Loc. supra cit.*

to be noticed that the net has no sharp corners or irritating angles, which might injure the tissues and lead to hæmorrhage, serous effusion and sinus formation. McGavin used the filigree shown in Fig. 52.

Operations for Ventral Hernia. Ventral hernia can be treated in one of the various ways described above as suitable for umbilical hernia, and therefore no special description is called for here. When the hernia is not too large, the normal anatomy can be almost completely restored after excising scar tissue and very thoroughly and carefully exposing and defining the muscular layers, generally without opening the peritoneum. But, when the gap is very large, various flap methods are the best and often the only means of success.

CHAPTER III

PERITONITIS

OPERATION FOR DIFFUSE PERITONITIS

ACUTE peritonitis is usually due to perforation of one of the hollow viscera or of an abscess and it begins as a local inflammation presenting local signs indicating the cause. Operation at this stage is almost invariably successful and should be undertaken without delay. When the perforation is large and the extravasation of infective material or pus is rapid and extensive, signs of diffuse or general peritonitis rapidly develop, so that by the time the surgeon sees the patient it may be difficult or impossible to determine the source of infection even when an accurate history is obtainable. Pneumococcal peritonitis is often diffuse from the beginning.

Operations have to be undertaken for diffuse peritonitis of uncertain origin the abdomen being uniformly rigid and fixed. The following classification of the causes may be useful.

(1) *Disease or injury generally causing perforation of the intestinal tract.* Instances of this group are laceration or wounds of the stomach or intestines, perforation of a gastric duodenal jejunal, or intestinal ulcer, perforation of Meckel's diverticulum or a diverticulum of the colon, perforation of a carcinoma of the stomach or colon perforation or sloughing of the intestine due to obstruction.

(2) *Disease of other viscera, e.g. acute pancreatitis suppurating ovarian cyst twisted ovarian pedicle, salpingitis rupture of pyosalpinx, septic metritis, puerperal peritonitis ruptured bladder, suppurating gall bladder or spleen.*

(3) *Pneumococcal septicæmia or pyæmia.*

(4) *Rupture of an abscess in the abdomen or parietes, especially appendical abscess and sub-diaphragmatic abscess.* These will be taken separately. By far the most common are perforation of the appendix, rupture of an appendical abscess, perforation of a gastric or duodenal ulcer and rupture of a pyosalpinx. In elderly people it is particularly important to remember the possibility of a perforation of a diverticulum of the colon.

Operation. In these cases the operation must begin as a thorough exploration. Therefore a long vertical incision near the middle line is adopted, a free opening being made so that the whole abdomen may be thoroughly and rapidly examined in a systematic way (Ch. I). The result of the operation depends a great deal upon the speed judgment and care of the surgeon who cannot afford to be delayed or hampered by a small incision. The edges of the wound are carefully protected to prevent contamination. Directly the peritoneum is opened liquid and gas frequently escape. Much may be learnt from the character of these. Odourless gas nearly always indicates perforation of a gastric or duodenal

ulcer ; offensive gas, disease of the appendix or of the lower part of the intestines. Thin straw-coloured fluid with or without flakes of lymph generally points to a perforation of the stomach ; occasionally solid particles of food are also seen. Bile-stained liquid usually indicates perforation of a duodenal ulcer, but occasionally of the gall-bladder. When the liquid is brown and offensive the perforation is almost certainly in the ileum or colon ; when it is blood-stained the omentum and mesentery are examined for fat necrosis indicating acute hæmorrhagic pancreatitis. The part indicated is at once examined and the suspicion is confirmed by the presence of thick adherent lymph near the site of perforation. When there are no definite indications the appendix is first examined because it is the most common cause of diffuse peritonitis. If this is healthy the stomach, duodenum, gall-bladder and pancreas are carefully examined. If this examination is negative the pelvis is examined, for there may be a perforation of a pyosalpinx or, in patients over middle age, of the sigmoid flexure above a growth or at an inflamed diverticulum. When the cæcum is distended the colon must be carefully examined for growth or perforation. A perforation of the small intestine is indicated by the presence of adherent lymph in its neighbourhood. Meckel's diverticulum should not be forgotten. Prolapse of the intestines is to be carefully avoided, for this increases shock and adds to the duration and difficulties of the operation.

Remove the cause. Whenever possible the cause of the peritonitis is removed. For instance, the appendix is excised or a perforated ulcer of the stomach or duodenum is closed.

Cleansing the peritoneum. When the infection is general or diffuse, and especially when there is extravasation of food or of fæces, the quickest method is irrigation. One or more supplementary small incisions are made above the pubis or in the flanks and a large rubber tube is introduced through each of these. Then a soft rubber tube with a funnel attached is introduced through the exploratory incision and is directed by the hand first above the liver and spleen, then into each loin and between the coils of small intestine, and, lastly, to the pelvis. Meanwhile the fluid runs away freely by the other tubes, and the irrigation is continued until the issuing fluid is clear. Willis¹ strongly advocates irrigation as a result of his experimental work on a large number of dogs, supported by his clinical experience. When the infection is limited to the lower half of the abdomen I prefer passing dry gauze rolls, each fixed at one end to the towels, to absorb the effusion while I remove the cause. This method is quicker, neater, and less likely to spread infection.

Drainage. The question of drainage is a very difficult one to decide. In early cases of spreading, but not general, peritonitis, surgeons are draining less and less, experience having shown that, if the cause be removed and the peritoneum be left clean and dry, the chances of complete and rapid recovery are greater without drainage of the peritoneum, which is capable of looking after itself under these circumstances. There is more risk of infection of the abdominal wall ; therefore the latter is not closed too accurately, room being left for the escape of any blood or secretions that may tend to accumulate in the parietal wound.

¹ *Surg. Gyn. and Obst.*, October, 1921.

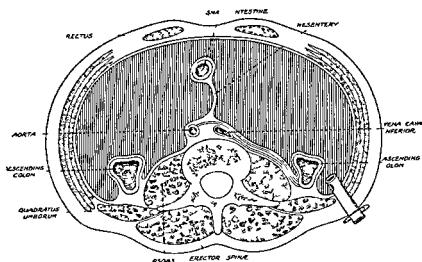


FIG 53 Drainage through the lesser sac

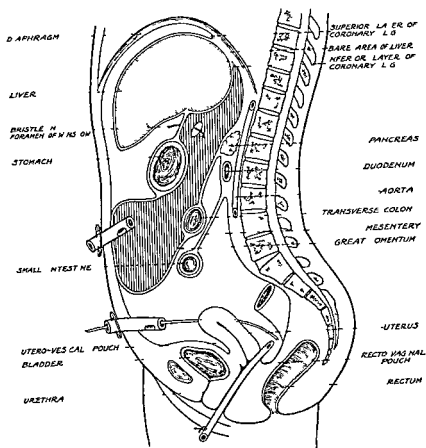


FIG 54 Drainage of the general and lesser sacs for peritonitis. The upper tube is suitable for perforation of a gastric ulcer into the lesser sac. The vaginal tube is suitable for peritonitis of pelvic origin.

When adopted, drainage may be only temporarily effective, but it certainly helps to save life in late cases, especially when all necrosed tissue cannot be removed or when bleeding cannot be entirely stopped. In such cases several small incisions are made by separating the muscular fibres. These may be made above the pubes, over each iliac fossa and sometimes above the iliac crests in the loin (*see* Fig. 53). In some cases, when the general infection is due to the rupture of an abscess in the pelvis, vaginal or even rectal drainage may be established (*see* Fig. 54). Split rubber tubes are inserted in the wounds already mentioned, and left *in situ* for about thirty-six hours. They extend only just through the abdominal wall, their chief function being to maintain the opening in the wall for the escape of effusions. Perforation of intestine or of arteries may result if they pass deeply into the

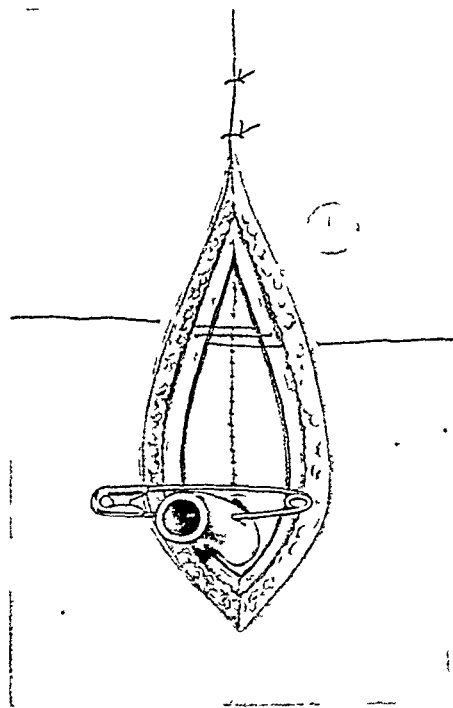


FIG. 55 Rubber tube with loose wick of rubber draining pelvis. The peritoneum has been closed above, and the rectus sheath is closed with "X" fishing-gut sutures.

abdomen and are left in too long. Secondary intestinal obstruction, perhaps years later, may follow the use of long drainage tubes in the abdomen, for they are potent causes of bands and adhesions. When the tubes are withdrawn the muscular fibres come together, so that there is no appreciable risk of hernia following. No tube is passed into close proximity to any closed perforation, for the tube prevents that adhesion of the perforated viscus to the neighbouring parts which is essential for the permanent closure of the perforation. In those rare cases, however, when it is impossible to close the perforation the tube extends near it, but must not press on the perforated viscus. The original incision is closed either entirely or in part, a tube being sometimes placed at one end. Whenever possible it is important to close the original wound entirely and to drain through supplement-

tary valvular incisions as already mentioned.

Paralytic Distension. In late cases, when there is much distension of the bowel, it is necessary to drain away its poisonous contents and at the same time to relieve the distension and kinking, and thus enable the intestine to regain its muscular power. In some cases the incision made with due precaution in the small intestine can be closed immediately after the distension has been relieved. In more severe cases a temporary valvular enterostomy is quicker and affords more lasting relief: sometimes entero-anastomosis is applicable and very satisfactory. In many of these cases great relief is afforded by frequently washing out the

stomach which soon fills by regurgitation from the intestines. A rectal tube and repeated turpentine enemata relieve distension of the colon. The sitting up position is most important after the operation.

OPERATION FOR EARLY OR LOCALISED PERITONITIS

When the cause is fairly certain from the history and local signs which often happens in appendicitis and perforated gastric or duodenal ulcer a local incision is made over the seat of infection. For appendicitis a grid iron incision is made over the appendix and a vertical incision is made through the upper part of the right rectus for perforation of a gastric or duodenal ulcer. When the peritonitis is limited to the lower abdomen and the cause is uncertain as often happens in women a vertical incision is made below the umbilicus and the rectus is displaced either outwards or inwards. Through these incisions either the appendix or suppurating Fallopian tubes may be removed. Upon opening the abdomen the first step is to pack off the healthy part of the peritoneum and the simplest and safest way to do this is to pass one or more gauze rolls in appropriate directions. One end of each roll is always clipped to the towels. When the disease is in the pelvis packs are first passed to both loins and next to the pelvis. Then the local disease is dealt with without fear of contaminating the general peritoneal cavity. In these early cases it is not necessary to irrigate. It is much quicker safer and less messy to absorb the effusion with gauze rolls gently passed. For instance a pack is passed into the pelvis while the appendix or tube is removed. When the pack is removed at the end of the operation the pelvis is quite dry and clean. When a localised peritoneal abscess is found great care is taken to pack off well before it is opened and to mop up all the pus and to clean the cavity out carefully with sterile gauze before proceeding to remove the cause such as a diseased appendix or tube. When deliberately operating for a localised late peritoneal abscess it is often possible to open this extra peritoneally. This is all that is necessary to save life in many bad cases. A radical operation can be carried out later if necessary.

SUBPHRENIC ABSCESS

An abscess may form under the diaphragm due to spread of infection from diseases of the stomach duodenum appendix liver spleen kidney or any other abdominal viscus. Far less commonly the source of infection is in the chest such as an empyema or in the ribs or spine and occasionally the abscess is pyæmic or due to gunshot or other wounds. The late H. L. Barnard¹ classified the subphrenic abscesses as *intra* and *extra-peritoneal* (of which the former is much the commoner) and *right* and *left* separated by the falciform ligament the right being a little more frequent. Further the lateral ligaments subdivide these into *anterior* and *posterior* of which the anterior are by far the commoner. The limits of an abscess due to perforation of a gastric or duodenal ulcer will be understood by reference to the accompanying illustrations. Fig. 56 shows the boundaries of an abscess produced by perforation of an ulcer in the anterior wall of the stomach. It will be seen to be limited below by adhesions between the great omentum and the anterior abdominal wall and above by the diaphragm and anterior layer of the coronary ligament of the liver. Usually

¹ *Br. L. Med. Journ.* 1908 : 371 409

the abscess involves one side only, being bounded internally by the falciform ligament of the liver. When secondary to perforation of a gastric ulcer the abscess is nearly always on the left side. In Fig. 57 is shown an abscess produced by a perforation in the posterior wall of the stomach. Here the abscess cavity involves the lesser sac of the peritoneum, the foramen of Winslow being occluded by adhesions. The third variety, shown in Fig. 58, will be seen to be in reality a retro-peritoneal abscess. Such an abscess will be caused by a perforation in the posterior wall of the stomach, where the two walls of the lesser sac of

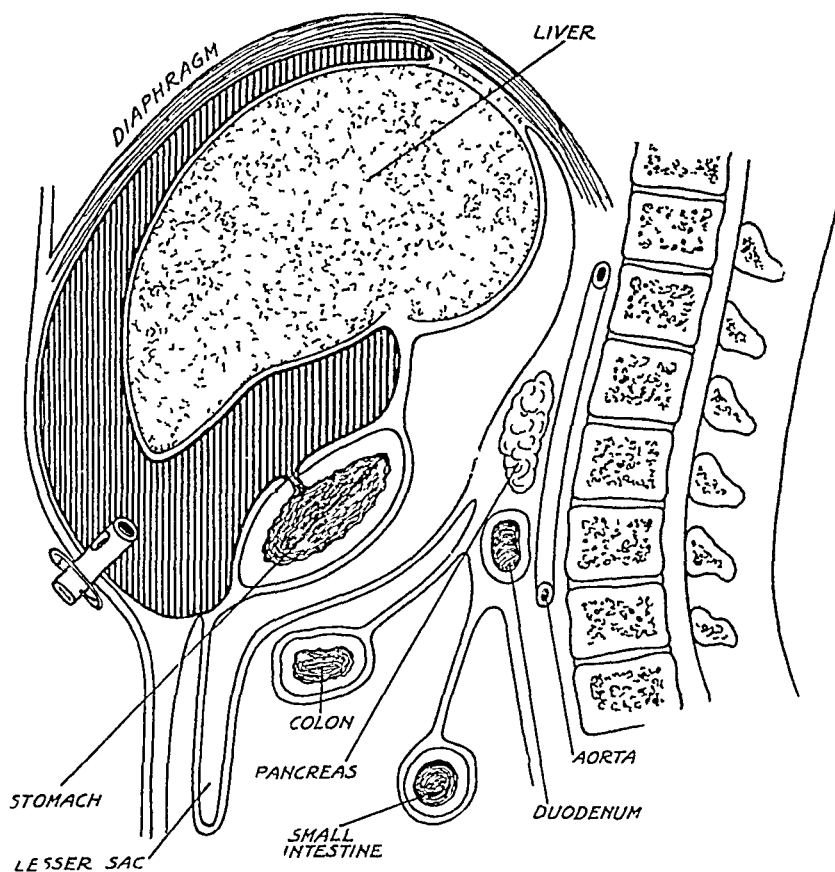


FIG 56 Anterior subphrenic abscess from perforation of an ulcer in the anterior wall of the stomach

the peritoneum have previously become adherent, or, in some cases, by perforation of a posterior duodenal ulcer. Although perforation of a gastric or duodenal ulcer is the commonest cause of subphrenic abscess, other causes may be mentioned. Of these appendicitis is the most frequent, especially neglected cases with suppuration, where no operation is performed or only performed very late. This complication is particularly liable to develop when there is suppuration in the loin, especially retro-colic. It may also follow leakage of infective material upwards and backwards during an operation for appendical abscess unless care is taken to introduce a pack into the loin above the abscess before the latter is opened. Suppurative cholecystitis is another important cause, and occasionally disease of the kidney gives rise to subphrenic abscess. In one

case after draining an empyema on the left side I opened a presenting sub diaphragmatic abscess through the diaphragm from above and thus removed a large renal calculus

Diagnosis¹ Remittent or intermittent fever with occasional rigors sweating rapid wasting anæmia increased dullness at one base of the chest and expansion of the lower part of the chest are to be found in some cases and occasionally local tenderness and œdema Pain referred to the corresponding shoulder is characteristic There may also be pulmonary signs especially of pleurisy and empyema Especially when of gastric origin the abscess may contain gas giving a succussion splash and *bruit*

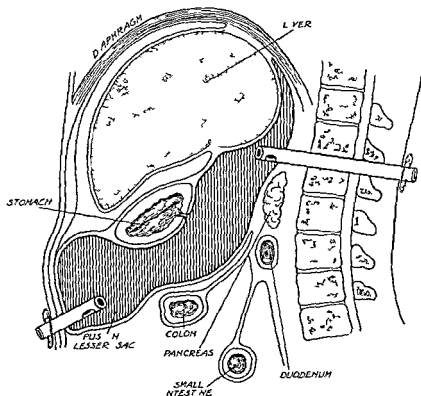


FIG. 37. Posterior or subphrenic abscess in the lesser sac of the peritoneum. Drainage tubes are shown entering front and behind.

as pointed out by Hilton Fagge many years ago then there may be below the normal pulmonary resonance dullness due to pleural effusion below this a resonant area due to gas under the diaphragm and lower still there is dullness over the pus liver or spleen Leucocytosis is usual An X ray examination is of great value showing limitation of the movements of the diaphragm with local elevation of it sometimes the presence of gas above liquid is demonstrated However I have known it mislead on several occasions once on the left when the stomach was confidently proclaimed to be a sub diaphragmatic abscess and twice on the right the retraction of a chronic pneumonic lung drew the diaphragm

¹ A. L. Lockwood, in an admirable paper discusses the differential diagnosis (*Collected Papers of Mayo Clinic 1913* 89).

² *Guy's Hosp. Rep.* 1873-74 33 3rd series p. 213

and liver up in a curious dome-shaped process closely simulating sub-diaphragmatic abscess. In each case a hand passed through an epigastric incision proved the absence of an abscess. A long exploratory needle of large calibre is frequently used to confirm the diagnosis, but it often fails to withdraw pus, which may be so thick as to block the needle. Moreover, the needle may do harm; once I struck pus at the twelfth attempt. *When grave suspicion of sub-diaphragmatic abscess exists, and when other means fail to discover it, the abdomen must be opened in the epigastrium, and a hand introduced. In a few seconds this serves to reveal and accurately locate an abscess, which can be drained at a suitable point generally from*

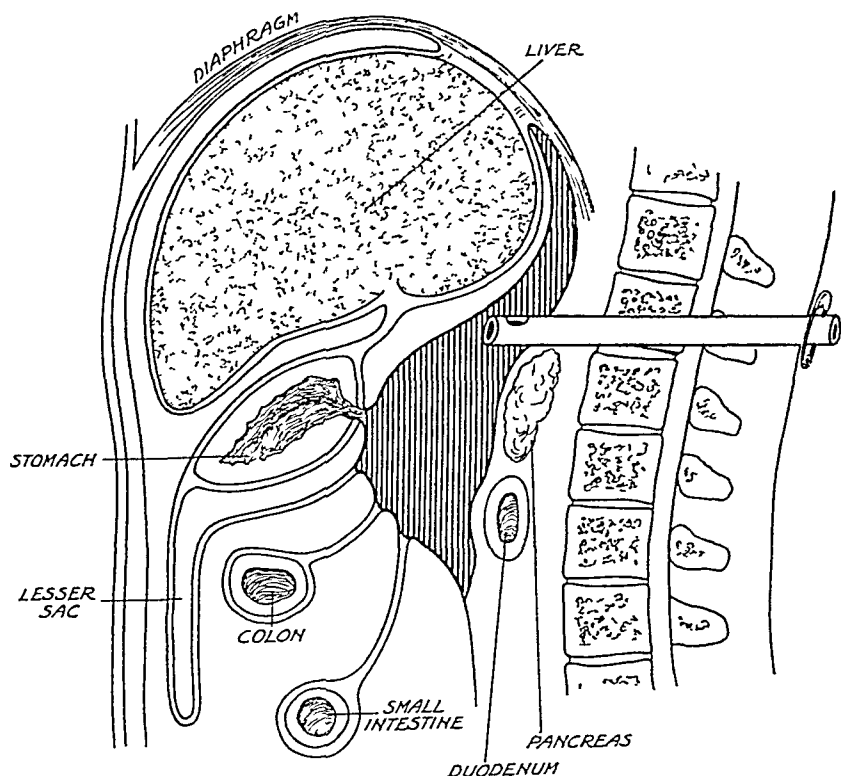


FIG. 58 Retro peritoneal subphrenic abscess from a gastric ulcer adherent to the back of the lesser sac

behind, the anterior wound being completely closed. In other cases the exploration reveals some other hidden cause of pyrexia, such as hepatic, or biliary splenic abscess.

Operation. The abscess having been located, it is opened and drained at the most advantageous point, either (1) through the chest wall below the pleura or (2) through the abdomen. The best route is often uncertain until the abscess has been definitely located and its limits ascertained by the hand gently introduced into the abdomen through an epigastric incision. In other cases the abscess bulges and causes œdema below the costal margin, and is opened at this spot. The left anterior intra-peritoneal abscess is generally most accessible through a left infracostal incision, but the majority of subphrenic abscesses, especially on the right side, are high, and are best reached and drained through a lateral incision in the chest wall. Sometimes a large or posterior abscess

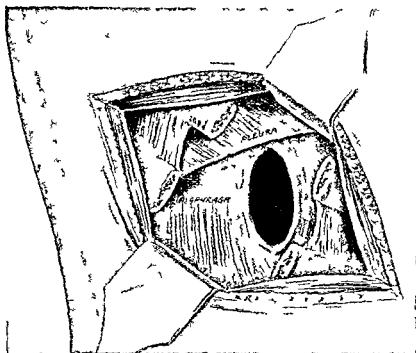


FIG 59 Opening sub-diaphragmatic abscess from behind below the pleural reflection

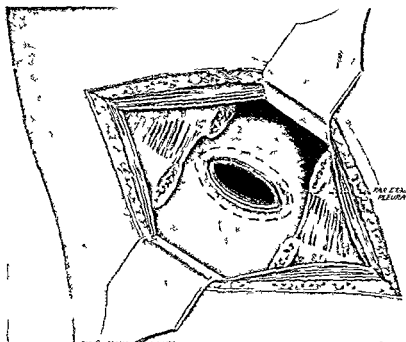


FIG 60 Opening sub-diaphragmatic abscess from behind through the pleura. The pleural cavity is sealed off by continuous suture of the parietal and diaphragmatic pleura

on the right side bulges below the last rib in the loin and is easily opened there.

(1) *Thoracic Incision.* Many of these patients are very ill and are best treated under morphia, scopolamine and local or paravertebral injection of novocain (1 per cent.). Ether and oxygen are at hand and are used if necessary. It is of the greatest advantage to avoid opening the pleura and thus adding the grave risks of pneumothorax and infection of the pleura; therefore the incision is to be made below the pleural reflection which runs parallel to, but at least one inch above, the costal margin. It is often an advantage to avoid the excision of a rib, with the attendant risk of pain, osteitis and bleeding from the intercostal vessels; therefore the ribs are merely separated with a good self-retaining retractor (Fig. 59).

An incision, four inches long, is made over the tenth or eleventh interspace, extending downwards and forwards from the posterior axillary line. The intercostal muscles are divided near the lower rib, and the pleura is either displaced upwards or sewn to the diaphragm. Lockwood¹ sews the parietal muscles above and below the wound to the pleura and diaphragm, thus shutting off the pleura and limiting infection of the parietes. He also sews the skin to the diaphragm for the same reason. In late cases the pleura is usually already infected, being inflamed and either adherent or containing pus or serum. In most of these cases it does little harm to go through the pleura in opening the abscess, but it is better to be on the safe side when in doubt. When an exploring needle is used it is safer to do so on the operating table, after the parts have been anæsthetised and, when pus has been located in this way, it is wise to remember Barnard's excellent rule to follow the needle when incising for drainage. The ribs having been separated, the diaphragm is incised, and the hand is introduced to find the abscess, which is drained with a large rubber tube containing a much longer one of smaller size extending into the deepest part of the cavity. Careful search is made for other abscesses or loculi, remembering how easy it is to overlook these. The tubes are sewn to the skin, and the cavity is daily irrigated through them with a weak solution of sodium hypochlorite.

(2) *Abdominal Incision.* (a) In some cases an oblique lateral incision is made at a suitable spot *parallel with the costal margin*, and the abscess found through this incision and drained either here or through a counter-incision in the loin. If the peritoneal cavity is opened before the abscess is found, a gauze pack is carefully placed to protect the peritoneum before the abscess is opened.

(b) In a few gastric cases a sub-diaphragmatic abscess bulges in the epigastrium and calls for *incision* here. Should the abscess involve the lesser sac of the peritoneum, it may be opened through the gastro-hepatic or gastro-colic omentum after the general peritoneal cavity has been shut off by careful packing with gauze, but it is sometimes better to drain it through the left loin.

The *prognosis* of sub-diaphragmatic abscess has greatly improved in recent years, partly owing to earlier diagnosis and more radical treatment. The mortality may be estimated to be about 25 per cent. at the present day, whereas it was as high as 50 per cent. twenty years ago. This was

¹ *Loc. supra cit.*

chiefly due to incomplete drainage, these abscesses being frequently multilocular or multiple. Without operation the mortality is over 95 per cent. Recovery is occasionally brought about by spontaneous rupture on the surface, into the lung, stomach, duodenum or colon.

OPERATION FOR PNEUMOCOCCAL PERITONITIS

It is important to remember that this condition is a part of a general pneumococcal septicæmia. For instance, the lungs, pleuræ, pericardium, endocardium or joints may be affected at the same time or just before. This makes the prognosis of the disease very grave. In some cases infection occurs through the intestine, especially the appendix, and the affection is then more local and less grave. Pneumococcal infection is always to be suspected, especially in children, when diffuse peritonitis with unusually rapid pulse and high fever develops without signs or symptoms of any local source of infection such as appendicitis or perforated gastric ulcer. The history or presence of herpes, pneumonia or pleurisy adds to the suspicion. In many cases, however, there are no means of telling the exact nature of the peritonitis until the abdomen is opened without finding any local source of infection. The peculiar character of the exudation may point to pneumococcal infection, which is confirmed by immediate bacteriological examination. Dr W. F. Annand and Mr W. H. Bowen¹ have recorded four cases of this disease and they were able to collect 91 cases, including their own, all these patients were children under the age of fifteen, the disease is much less common in adults. In 30 cases the peritonitis was secondary to a lesion elsewhere, especially in the lungs and pleura. Primary infection had occurred in the throat or middle ear in several cases. In 45 patients the peritonitis was considered to be primary, possibly due to infection from the intestines, especially from the appendix. In 44 cases there was such a rapid spread of the infection that it was impossible to decide upon any primary seat.

The pus is nearly always thick and odourless; it may have fibrinous or jelly like masses floating in it, and layers of greenish yellowish lymph are deposited on the peritoneum and intestinal coils. The peritonitis may be localised or diffuse, sub acute or acute. The sub acute form generally starts acutely, but there is a great tendency towards the formation of circumscribed sub acute abscesses, so that a diagnosis of tuberculous peritonitis is quite likely to be made. The acute form is generally mistaken for peritonitis due to appendicitis, unless a primary pneumococcal lesion is known to exist. The character of the pus and the absence of any discoverable source of the peritonitis and immediate microscopic examination should make the diagnosis clear during the operation. A similar but even graver peritonitis sometimes occurs as a part of streptococcal septicæmia and occasionally follows scarlet fever.

Treatment. Localised abscesses should be incised and drained. In the acute diffuse form the diagnosis will usually be made when the abdomen is opened for peritonitis of uncertain origin. When the diagnosis can be made with anything approaching certainty, Cameron suggests that it may be better to defer operation until the septicæmia has subsided. As it is, the mortality of operations for diffuse pneumo-

¹ *Lancet* 1906 i, 1091

coccal peritonitis is very high ; so that it is reasonable to wait a while if the patient is very ill, and especially if there are signs of pneumonia, pleurisy or pericarditis.

Bowen advises mopping out the pus and closing the wound completely if the pus be sweet ; but if the pus be evil-smelling, indicating mixed infection, drainage should be adopted.

The prognosis. The following Table from Annand and Bowen speaks for itself :

Variety of peritonitis.	Number of cases.	Number of cases operated on.	Number of cases not operated on.	Result.		
				Recovery.	Death.	Uncertain.
Primary local	26	26	0	22	3	1
Secondary local	11	10	1	9	1	1
Primary diffuse	21	10	11	2	19	—
Secondary diffuse	19	5	14	3	16	—
Origin uncertain { Local	8	8	—	6	2	—
	Diffuse	6	3	1	5	—
Total	91	62	29	43	46	2

“ Forty-five of the 91 cases had encysted peritonitis, of which 44 were operated on, and of these 37 recovered and 6 died ; in 2 the result is uncertain. The other 46 cases were of the diffuse variety, 18 of which underwent operation. Of the 18 cases operated on, 6, or 33·3 per cent., recovered, whereas all those not operated on died. The one case of the local variety not operated on recovered by spontaneous evacuation of the pus. The above Table shows that recovery occurred in 86 per cent. of those with the encysted form, whilst only 14 per cent. of the cases with the diffuse variety survived.”

Rischbieth¹ records 57 cases ; of these, 3 were adults, who all died, and 54 were children, of whom only 6 recovered ; in these the collection was localised. Carmichael² reports 20 cases with 35 per cent. mortality. H. C. Cameron³ analysed 26 cases occurring at Guy's Hospital between 1903 and 1912. Nineteen of the patients were females, and of these 15 were little girls between 5 and 15 years. Twelve patients were submitted to immediate laparotomy ; 9 of these died, 3 recovered, but the laparotomy performed at the onset of symptoms failed to produce immediate improvement. The patients passed through a long and critical illness, developed residual abdominal abscesses and recovered after the evacuation of the pus. Of 8 patients considered unsuitable for operation, all died. On the other hand, 4 patients admitted after recovery from pneumococcal septicæmia with quiescent residual abscesses made good recoveries after operation.

It is probable that this form of peritonitis is more common than is suspected at present, and that a more general bacteriological examination of the pus in cases of peritonitis will prove this assertion.

¹ *Quart. Journ. Med.*, January, 1911.

² *Brit. Med. Journ.*, September 18, 1909.

³ *Proc. Roy. Soc. Med.*, 1912, i, pp. 123-133.

OPERATION FOR TUBERCULOUS PERITONITIS

It is important to remember that tuberculous peritonitis is secondary to tuberculous disease elsewhere which may be latent or overlooked. The direct source of infection is generally within the abdomen i.e. tuberculosis of the Fallopian tubes, appendix, mesenteric glands or intestine, especially in the ileo-caecal region. The disease chiefly affects children, more than half of those affected are under six years of age, the source being tuberculous milk for the bovine bacillus is found in about 60 per cent. of the cases¹. Therefore it is most important to eliminate the tuberculous cow or failing this to sterilise all milk from untested cows. Similarly tuberculous mothers should never suckle their infants.

Indications for operation. The relative advantages of medical and surgical treatment for this disease have been much debated but it is now agreed that operation is strongly indicated in selected cases. It is certain however that spontaneous recovery takes place and that the disease may cause no perceptible symptoms or signs. Medical treatment with plenty of good food, fresh air and sunshine cures many cases, possibly 50 per cent. as suggested by Rolleston. In 1862 Sir Spencer Wells operating as he thought for ovarian cyst found and cured tuberculous peritonitis by simply letting out the effusion. König² in 1890 reported 139 operations with 84 recoveries, 24 being well more than two years later. In 1890 Roersch published 358 cases with the following results. The deaths immediately due to the operation numbered 39, deaths at a later period (within eighteen months) and due to extension of the disease, general tuberculosis etc. numbered 51. In the rest of the cases improvement followed and many were apparently cured. For instance in 53 cases two years and upwards had elapsed since the operation and the patients were apparently cured. As pointed out by Sir Watson Cheyne many cases relapse even after prolonged periods of apparent cure and moreover the successful cases are more likely to be published than the failures. He³ as a result of his own experience considered that improvement took place in about 50 per cent. of the cases and he stated moreover that in many the rapid improvement after operation was most remarkable.

Halstead⁴ stated that over 1500 cases of tuberculosis of the peritoneum treated by operation had been recorded. The percentage of recoveries in the ascitic form is from 40 to 50 per cent. and in the adhesive form about 25 per cent. After five years freedom from recurrence the disease may be considered to be cured.

In opening a discussion upon this subject at a meeting of the British Medical Association in 1911 Sir Humphrey Rolleston⁵ discussed the indications for operation. As an experienced physician who has given the subject much attention and has studied the literature extensively his view upon surgical treatment are valuable.

It may be stated as generally agreed (1) that operation is contra-indicated in generalised or widespread tuberculosis and therefore in infants under 12 months of age and in patients with signs of pulmonary tuberculosis. (2) That it is unnecessary in the fibrous and adhesive

¹ C. H. Mayo *Minnesota Med.* 1901 iv 759-764

² *Cent. f. Chir.* 1884 x 81-83 and 1890 xv 657-660

³ *Lancet*, 1899 1770

⁴ *Amer. Med.* January 31 1903

⁵ *Brit. Med. Journ.* September 2 1911 p. 473

forms in the absence of any urgent symptoms of intestinal obstruction. (3) That it is necessary in cases of abscess formation and in intestinal obstruction. It must be remembered that the last complication may be simulated by the onset of tuberculosis meningitis. The question of operative interference therefore concerns cases of ascitic abdominal tuberculosis. . . .

" . . . *The question of operation on ascitic cases may be fairly summed up in the statement that it should be tried after hygienic and medical treatment has been given a fair trial without any definite benefit.*"

The cause of the marked improvement generally following simple abdominal section is uncertain. J. B. Murphy¹ points to hyperæmia and proliferation of the peritoneal tissues as very important factors. Three or four days after the laparotomy the peritoneum is "intensely congested, its gloss almost or quite abolished, and the fluid not fresh, clear serum, but cloudy or seropurulent, showing the most active proliferation."

From the point of view of surgical interference in this disease, the following classification of the principal types or *stages* of the affection is important.

A. *The ascitic.* Here the inflamed peritoneal sac and its contents are studded, as far as can be seen, with hosts of grey "sago grain" granulations, tending to become confluent. Caseation is absent, or only present in a very early stage. The fluid is rarely seropurulent. Adhesions are absent or insignificant. The fluid here may be localised and encysted. The ascitic form may come on very insidiously and is not uncommonly the subject of a mistake in diagnosis, especially in women in whom ovarian cysts or ascites due to ovarian carcinoma may be difficult to distinguish from tuberculous peritonitis; ascites due to cirrhosis of the liver has been confused with this disease.

B. *The caseating and purulent.* Here caseation is always present; the amount of pus varies. Usually this is abundant and is too often encysted, imperfectly, in many collections. More rarely the caseation is dry, unattended with effusion, the intestines being matted together by adhesions which are themselves infiltrated and caseating. If the adhesions are separated, hosts of small loculi present themselves, with scanty fluid, usually purulent. The caseating is the variety which we see so typically in wasted children with hectic fever, vomiting and diarrhoea. In some cases secondary infection of local collections from adherent intestine is indicated by high fever with rapid increase of swelling. Sometimes the abscess contains gas, which makes it very deceptive.

C. *The fibrous.* This is the rarest, but a favourable variety. The bacilli are probably few. Caseation is absent, and any fluid present serous and scanty. In this form and the second, if such parts as the omentum and mesentery are densely infiltrated, a new growth may be closely simulated.

The amount of improvement after operation that may be expected in any case of tuberculous peritonitis depends chiefly upon two considerations: (1) The stage which the disease has reached, and (2) the type of disease that is present.

(1) *The stage of the disease.* It is most important that the operation should be undertaken in the ascitic stage, before adhesions have formed and before the vitality of the patient has been much diminished by general

¹ *Tub. of the Female Genitalis and Peritoneum*, Chicago, 1903, p. 119.

failure of nutrition hectic fever or tuberculous disease of other parts etc in order that the effect of the operation itself may be quickly recovered from In the advanced stages of the disease the shock alone of the operation may be sufficient to bring about a fatal result or in any case to hasten the end

(2) *The type of disease* The most favourable cases are those belonging to Class A where there is free fluid and the adhesions are few Classes B and C are not so favourable Here the operation may do much harm for adhesions are numerous and the wall of the bowel often much thinned The result of manipulation is frequently the production of one or more fecal fistulæ with perhaps the setting up of acute suppuration but local collections of serum or pus have to be opened and the source of infection or reinfection such as a diseased Fallopian tube or appendix may have to be removed

Mr Wright¹ from his own experience and information obtained by Mr Jefferson who traced many of Mr Wright's patients concludes that

(1) Probably not many more than half the cases would live to grow up for of those who recover for a time a large proportion die of tuberculosis in some form within a few years though the immediate operative mortality is of course very small

(2) There is no hard and fast line between ascitic and plastic cases either as a matter of morbid anatomy or of operative treatment or of mortality But operation is simple where there is much fluid and may be impossible in obliterative cases

(3) Tuberculous mesenteric glands may be safely removed and in some cases certainly should be removed

(4) The role of surgery in tuberculous peritonitis is rather to remove secondary troubles such as obstruction and to get rid of noxious collections of fluid and local foci of tubercle rather than to play any great part in the prevention or cure of the disease as a whole

C H Mayo² says that only the cases with general or local ascites or the cases of the plastic type with pelvic masses are to be considered surgical The mortality of 190 operations in the Mayo clinic between 1907 and 1920 (153 females and 42 males) was 1.5 per cent

Operation Usually it is best to open the abdomen near the middle line below the umbilicus taking care to make a valvular opening by displacing the right rectus outwards Through this incision the cæcum Fallopian tubes the ileum and the mesenteric glands can be easily examined and dealt with and the wound when completely closed is not likely to be followed by hernia The escape of fluid may be facilitated by turning the patient on to his side and the peritoneum thoroughly dried by means of gauze rolls clipped to the towels and passed in various directions Where the fluid is loculated by means of adhesions the separate loculi may be made to communicate by gently breaking through such of the adhesions as may be necessary for this purpose No extensive disturbance of the adhesions beyond this is either necessary or advisable In some cases an obvious primary seat such as a tuberculous Fallopian tube cæcum appendix or caseous gland may be discovered This should be removed if the condition of the patient

¹ *Loc sup cit* Brit Med Assoc Meeting 1911

² *Loc supra cit*

PERITONITIS

be such as to admit of the necessary prolongation of the operation, and if the adhesions are not so numerous as to render the procedure very dangerous. In some cases, however, in which such a primary focus is found, it will be firmly fixed to other important structures or embedded in a mass of adhesions; in such cases the wiser course will generally be in making no attempt at a radical operation, but in resting content with letting out the ascitic fluid as described above. When the condition of the patient will not allow the resection of a tuberculous cæcum short circuiting should be performed, the ileum six inches above the disease being joined to the ascending or transverse colon. There is nothing to be gained by either washing out the abdominal cavity or by drainage, so that as soon as all the fluid has escaped the abdominal wound should be closed in overlapping layers and the dressings applied.

In January, 1910, an undergraduate, aged 20, complained to his tailor, saying that his clothes did not fit him properly. Then his friends noticed that his abdomen was getting larger, and he had a little diarrhoea and wasted a good deal. He returned home in the middle of March and saw Dr. Lipscomb of St. Albans and Dr. Lauriston Shaw in consultation. A diagnosis of tuberculous peritonitis was made, and an operation was advised. I performed this at the middle of March, 1910. The patient was then thin and cyanosed, probably owing to the enormous distension of his abdomen interfering with his respiration. The lower part of the right rectus was displaced outwards. The parietal peritoneum was very thick and there was considerable oedema of the sub-peritoneal tissues. There were no adhesions. A very large amount of dark yellowish clear fluid escaped. The parietal peritoneum and the small intestines were studded with tubercles, some of which were caseous. The intestines were very vascular, partly due to the release of pressure by the sudden escape of the liquid. The cæcum was bound down, and the appendix was found to contain a calculus and to be adherent behind the cæcum and the lower end of the ileum. It was thought wise to remove it. There was some difficulty in getting the cæcum into the wound, and in separating the appendix from dense localised adhesions. The calculus was in its basal third. Its distal two-thirds were firmly bound down and the lumen was almost obliterated. The extremity was fibro-caseous, and on microscopic examination this proved to be tuberculous. There were a good many moderately enlarged mesenteric glands, and at one part the small intestine was thickened and rather kinked towards the mesentery. An ulcer was found to be present at this spot. The cæcum was not thickened. Afterwards the patient lived an open-air life, and although some fluid collected in the abdomen again, his general and local conditions improved so that three years afterwards he was quite well and strong and leading a very active life. He was well in 1926.

If on opening the abdomen the case is found to belong to Class B, great care and gentleness must be used in opening up and dealing with abscess cavities, for the walls of the intestines are frequently thinned and softened by the disease, so that any undue roughness in handling is extremely liable to result in rupture of the bowel, either at the time or later, causing faecal abscess or fistula. No attempt should be made in such cases at eradicating the disease, but abscess cavities may be treated as tuberculous collections elsewhere are treated, by evacuating the contents, gently swabbing out the cavity with sterilised gauze and then closing it. If the pus is, however, found to be faeculent owing to infection from the bowel, the abscess must be drained with a tube just reaching the cavity, but not pressing on its wall, which may be formed by thin-walled intestine.

The writer's experience of operations for the ascitic form of tuberculous peritonitis, especially when a source of infection has been found and removed, has been very satisfactory.

CHAPTER IV

OPERATIONS UPON THE STOMACH

GASTROTOMY

Indications An opening is made into the stomach for the removal of foreign bodies which will not pass through the pylorus such for instance as knives forks nails coins or masses of hair Increasing pain vomiting emaciation and failure of the foreign body to pass in a few days are the general indications An X ray examination should always be made to prove the presence and locate the position of the foreign body In a few cases the operation is required for the removal of foreign bodies impacted low down in the œsophagus or for exploring the interior of the stomach

Operation A For the removal of foreign bodies from the stomach. A vertical incision to the left of the middle line is generally the most convenient the left rectus being displaced outwards The abdomen is opened the edges of the wound are carefully protected with pads and the exact site of the foreign body is made out If this be pointed great care is taken not to let it damage the stomach during the manipulations In such cases the abdominal wound must be free so that the surgeon may see what he is doing In the case of such a body as a fork the blunt end must first be found

When the surgeon has decided where to open the stomach he brings this part out of the wound and packs sterile gauze all around and behind it Whenever possible he applies a clamp behind the foreign body to prevent bleeding and leakage and to retain the pouch containing the foreign body outside the abdomen

When it is impossible to use clamps owing to the large size or awkward shape of the foreign body a vertical incision is made through the anterior wall of the stomach which is held by forceps and all bleeding vessels are at once tied The body is next extracted with suitable forceps or scoop care being taken to avoid damage of the stomach and to prevent any blood or mucus escaping into the parietal wound or peritoneal cavity

The aperture in the stomach is closed with a continuous suture which pierces all the coats and inverts the edges of the wound after Connell's method This is reinforced by a continuous Lembert suture The packs are removed and the parietal wound is closed

B For removal of bodies, *e.g.* tooth plates impacted in the lower part of the œsophagus These cases though rare with the perfection of the œsophagoscope are so difficult as to call for some remarks here Professor Richardson of Harvard University first brought forward a very successful case of this operation¹ A plate carrying four teeth had been impacted eleven months in a patient aged 37 Numerous attempts had been made to remove it through the mouth The plate was success

¹ *Lancet* 1887 i 70

fully removed by gastrotomy. The following interesting details are given :

Determination of the site of the foreign body. In an individual of average height, and with a neck of ordinary length, the distance from the incisors to the diaphragm is fourteen and a-half inches. All parts of the œsophagus are accessible to the finger either by gastrotomy or external œsophagotomy. With the right forefinger introduced by œsophagotomy and the left by gastrotomy it was found possible, not only to make the fingers touch, but in many cases overlap. But these results are only approximate, as it would not always be possible to do both operations on a patient. It is possible to reach with the left hand three inches above the cardiac opening, *i.e.* the length of the left middle finger. From above, through the wound in the neck, one cannot reach quite so far on account of the sternum and clavicle. Allowing in the average neck one and a-half to two inches from the cricoid cartilage to the lowest point of the wound in the œsophagus, we have the average distance from that incision to the cardiac opening of five and a-half or six inches. If the obstruction be less than six inches from the cricoid, an attempt should be made to remove it from above¹; if more than this, or thirteen inches from the teeth, gastrotomy should be performed. The incision that, on the whole, is recommended is oblique, one inch below and parallel to the left costal margin. The left rectus is divided and the incision is similar to the one used on the right side for gall-stones. Packs of gauze are carefully placed to isolate the field of operation. The stomach being drawn up into the wound, it is most essential to put the lesser curvature on the stretch, so that it makes a straight line to the diaphragmatic opening. The incision in the stomach wall must be far enough to the right to allow the passage of forceps along the sulcus between the anterior and posterior walls of the stomach, made tense as above. If the instrument is brought obliquely to this groove and passed upwards, all the time being pressed gently against the straightened lesser curvature, it will glide into the œsophagus every time with the greatest ease. The opening in the stomach should be first large enough to admit forceps; if these fail, it must be enlarged transversely to admit two fingers, and the whole hand introduced into the abdomen. The anterior wall then invaginates in front of the hand as the fingers seek the œsophagus.

M. Bluysen² performed gastrotomy and removed a denture which had been swallowed a fortnight earlier and had become impacted near the cardiac orifice. Forceps having failed, the index finger was introduced into the lower end of the œsophagus and served to hook and remove the plate.

C. For dilating strictures of the œsophagus from below. Where non-malignant strictures low down in the œsophagus resist dilatation from above, and the patient is losing ground, the stricture may be attacked from below in one of the following ways :

¹ Mr. Fullerton (*Brit. Med. Journ.*, May 7, 1904) performed œsophagotomy and removed a halfpenny which had been impacted for seven months opposite the third and fourth dorsal vertebræ, and four and a half inches below the wound. The wound was closed by deep and superficial sutures of catgut, and the child, æt. 7, recovered.

² *Lancet*, 1906, i, 192.

(1) *By gastrotomy* the opening being closed at the same time Professor Loreta, of Bologna operated on the first case in 1885¹

The patient aged 24 had swallowed caustic alkali. Attempts to dilate the stricture by bougies were unsuccessful and at last it became impossible to pass any instrument. The point at which the sound was arrested seemed to correspond with the fourth dorsal vertebra. The patient was entirely unable to swallow, and emaciation had become extreme. Eleven months after the injury an incision about five inches long was made from the xiphoid cartilage downwards and to the left. Some difficulty was met with in finding the stomach owing to its contraction and the way in which the liver overlapped it but at length the operator succeeded in drawing the greater part of the stomach out of the wound and a longitudinal incision was made through its walls between the two curvatures having its upper end as near the cardia as possible. The next step was to find the orifice of the œsophagus in order to introduce the dilator but this involved considerable difficulty² and the search was interrupted by a considerable quantity of bile which regurgitated from the duodenum into the stomach. At length by searching with the left index finger between the under surface of the liver and the small curvature of the stomach the end of the œsophagus was found. Then the distended stomach was kept drawn down by an assistant while the operator introduced a dilator (something like that of Dupuytren for lithotomy). The wound was then sewn up and the stomach returned. The patient rallied well and in six hours swallowed some soup with the yolk of an egg to his great joy as for twelve months he had been unable to do more than swallow mouthfuls. Recovery is stated to have been complete.

Mr Kendal Franks has related an instructive case of the same kind³

Here the whole of the right hand was introduced into the abdomen and the index finger into the stomach through an opening an inch long situated about midway between the curvatures and the orifice. As the finger could only just reach but not dilate the stricture an Otis dilating urethrotome (the blade having been removed) was guided by the finger into the stricture screwed up and withdrawn full expanded. After this had been done both laterally and antero posteriorly an œsophageal bougie could be easily passed through the stricture from above. The wound in the stomach was united with two continuous sutures one uniting the mucous membrane the other by Lembert's method the peritoneal coat. The patient made a good recovery. Large sized bougies could be passed without difficulty or pain.

It is clear that the above method may be resorted to with great benefit in non malignant strictures low down in the œsophagus where the dilated and knicked condition above the contraction makes it very difficult to cut this off with a bougie with the aid of the œsophagoscope, and where attempts to swallow a guiding silk thread have failed.

Cardiospasm before its pathology was well understood has been satisfactorily treated in a similar way but the Hurst rubber tube filled with mercury and passed through the mouth is much safer and better and rarely fails.

(2) *By gastrotomy* This while rendering manipulations safer in a measure, cripples the surgeon's movements as it will be impossible, however much the fistula be dilated to get the finger passed through it anywhere near the stricture in the œsophagus.

Instrumental dilatation can alone be made use of through a gastric fistula and for this reason the method by two stages is inferior to the other. It has been most ingeniously used under the following circumstances

¹ An excellent summary of Prof Loreta's cases is given by Mr Holmes (*Brit Med Journ*, February 21, 1886)

² See the directions given at p 100

³ *Ann of Surg*, 1894 i 393

In 1889, Hagenbach¹ directed a patient with a non-malignant stricture of the œsophagus to swallow a small shot attached to a long thread. This was drawn out of the stomach through a fistula, and a long silk thread fastened to it and drawn up up through the mouth. To the lower end a bougie was tied, and increasing sizes were daily drawn through the fistula.

Dr. R. Abbe, of Newport,² advises what he calls the "string" method in the treatment of dense fibrous strictures. A gastrostomy having been previously performed,³ a small gum-elastic bougie is guided through

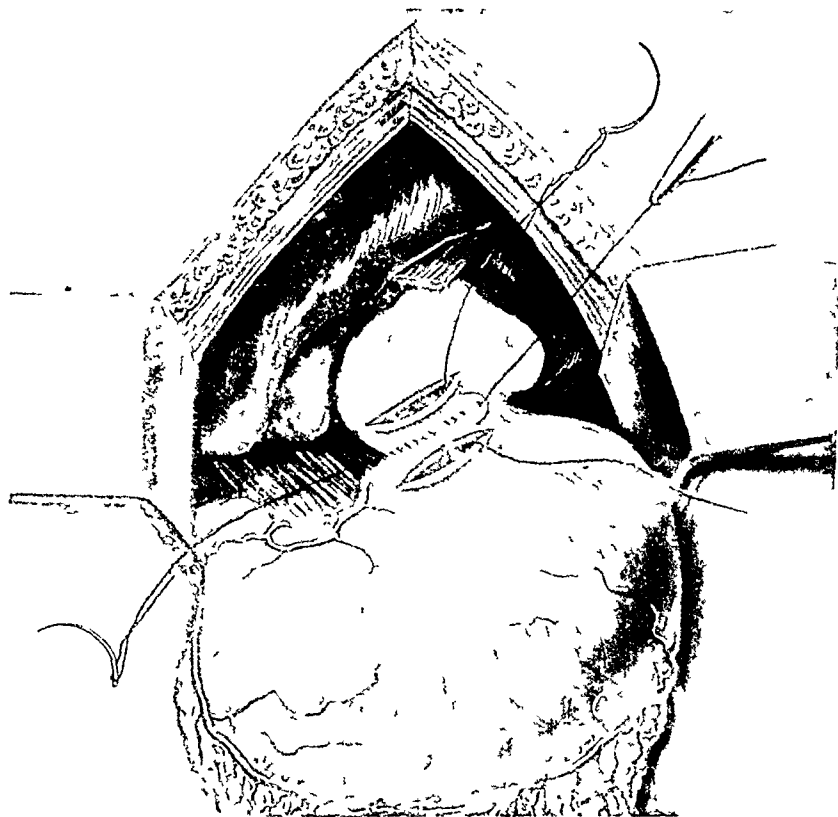


FIG 61 Oesophago gastrostomy The dilated lower end of the œsophagus is exposed through the diaphragm and joined to the stomach as in gastro gastrostomy with a small cardiac pouch (After Lambert, *Surg, Gyn and Obst*, January, 1914)

the stricture from below up into the mouth, and a stout silk ligature passed in the same way. This silk being see-sawed backwards and forwards, the stricture is felt to yield, and larger bougies can then be passed.

Mr. Dunham⁴ has devised a simple and ingenious way of getting a thread through a stricture of the œsophagus. He uses "an ordinary drinking tube, a glass of water, and a piece of black silk thread. The tube is threaded so that one end of the thread is at the mouth end of the tube. The patient then drinks through the tube. The thread is carried up the tube and on into the œsophagus by the current of water.

¹ *Correspondenzblatt Schweizer Aerzte*, No. 5.

² *Ann of Surg*, 1893, 1, 489.

³ In this and the preceding instance the gastrostomy opening should be placed as high up as possible. In his case, Dr Abbe opened the œsophagus near the root of the neck as well as performing a gastrostomy.

⁴ *Ann of Surg*, 1903, XXXVII, 350.

More thread is fed into the water as it disappears up the tube, care always being taken that it is not fed in too rapidly. When several feet of thread have been thus washed down, the lower portion of the thread may be fished out of the stomach by means of a bent probe, passed in at the gastrostomy opening. In some cases this method may fail from want of co operation on the part of the patient, and the thread may then be introduced through a funnel and rubber tube, the latter being passed into the pharynx or œsophagus. Once the thread has been introduced, larger ones will follow, and these can be used as suggested by Abbe. Some rubber tubing, kept upon the stretch by traction upon a string attached to each end of it, can be introduced, as suggested by Curtis. This effects dilatation very rapidly, and larger ones can be introduced until biconical French bougies can be used with ease, and the gastrostomy wound closed.

Dr Dowd¹ records a very interesting and successful case of simple stricture near the cardiac end of the œsophagus, which was impermeable from above and also from the stomach. Dunham's method of introducing a thread was tried, and failed. Kelly's cystoscope tube was used to locate the cardiac orifice from below and to conduct bougies to the orifice, but the bougies would not pass. Dunham's plan was tried again and proved successful. The stricture was dilated by the methods of Abbe and Carter, and within two months large (No. 28) bougies could be passed with ease, and ordinary food partaken of. The gastrostomy wound had been dilated for the introduction of the cystoscope, and leakage therefore occurred, so that it became necessary to close the fistula by an operation.

In such a case, an emaciated little girl aged six, my late house surgeon, Dr B. G. Scholefield, in 1920, succeeded in passing a ureteric catheter up into the mouth through the cystoscope introduced through a gastrostomy opening. All efforts to swallow food or a silk thread had failed completely, so that the gastrostomy had become necessary to save life. A stout silk thread was used to replace the ureteric catheter and served as a guide for the passage of larger bougies from the mouth, with the happy result that the child was able to eat full diet and made a good recovery. She was well and had gained greatly in size and weight a year later.

The Treatment of Achalasia Cardia (Cardiospasm). For obstinate diffuse dilatation of the œsophagus Lambert² successfully performed œsophago gastrostomy (see Fig. 61). One of us (R. P. R.) successfully divided the cardiac sphincter in a case of achalasia cardia³ (so-called cardiospasm) in an emaciated man, the only one of fourteen cases which Dr A. F. Hurst had failed to relieve with his mercury tube. The following is an account of the operation.

Operation. At Guy's Hospital on February 15th, 1924. Intra tracheal anæsthesia was given by Dr E. A. Scott to lessen the movement of the diaphragm. A long oblique incision was made one inch below the left costal margin, the fibres of the left rectus were divided, and the superior epigastric artery tied. The left seventh costal cartilage was divided close to the sternum and also the seventh and eighth about two inches lower down, the intervening portions being removed. This allowed a very free retraction of the left costal margin and gave a good view. The left lobe of the liver was mobilised by dividing the left lateral hepatic ligament and separating the liver from the diaphragm for three inches. The left lobe was folded backwards and drawn to the right to display the cardiac orifice of the stomach. The stomach was then drawn downwards and to the right, the peritoneal reflections from it to the diaphragm at the cardia were divided, and the œsophagus was gradually drawn down so that ultimately a length of about one and a half inches was visible in the abdomen. A large mercury tube was then introduced from the mouth,

¹ *Ann. of Surg.*, 1904, xxxix, 272.

² *Surg., Gyn. and Obst.*, January, 1914.

³ *Proc. Roy. Soc. Med.*, 1923-24, xvii, Clin. Sec., p. 45.

but was arrested in the œsophagus about one and a-half inches from the stomach. The oblique muscular fibres at the cardia were separated and the deeper circular fibres were cut across along the front of the œsophagus for at least an inch. The sphincter was so thin and wide as to be difficult to recognise; there was certainly no hypertrophy of it. In trying to make sure that none of the fibres were left undivided the mucous membrane of the œsophagus was opened about half an inch above the stomach. This hole was closed with two fine catgut sutures. The mercury tube than passed easily into the stomach.

It was noticeable that the part of the œsophagus visible in the abdomen was not dilated, but was natural in size. The stomach was smaller than normal. The wound was then closed except that a small rubber drain was left at its outer angle and extending towards the cardia.

The morning after the operation the patient knew that his obstruction had been corrected, for no saliva had accumulated in the œsophagus and he missed the usual feeling of distension of the latter. He had been accustomed to bring up half a pint of saliva every morning.

He was kept on rectal salines and glucose for the first three days, only a very little water being given by the mouth. Fluids were then given by the mouth, but two days later they began to leak through the lower part of the abdominal wound. Mouth feeding was stopped for two days and the patient put back on rectal salines, but he disliked these so much and became so intolerant of them that feeding by the mouth was begun again, thicker food, such as milk puddings and porridge, being given with great advantage. Hardly any leaked, and within a week the sinus had healed and the patient was able to swallow almost any kind of food. He gradually improved, and a year later had gained nearly two stones in weight.

GASTROSTOMY

An opening is made into the stomach for introducing food directly into it when swallowing and intubation are impossible and starvation is impending. It may also be used for dilating œsophageal strictures as above. It is important to make the opening valvular to avoid leakage of gastric juice, which makes the skin raw and burning so that life becomes a misery.

Indications. (1) Certain cases of carcinomatous stricture of the œsophagus. (2) Cancerous disease of the pharynx; and, in a few cases, malignant disease of the tonsil or back of the tongue not admitting of a radical operation. (3) Carcinoma of the cardiac end of the stomach. (4) Cicatricial stricture, whether traumatic or syphilitic. (5) It has been performed for cardio-spasm, but dilatation with the rubber tube filled with mercury is better and generally succeeds. The first of these requires separate notice.

Carcinomatous stricture of the œsophagus is common and its treatment very unsatisfactory because successful resection is rarely possible. Gastrostomy may be performed either as a preliminary to resection or as a palliative operation.

Lilienthal¹ in his successful resection of a carcinoma of the thoracic œsophagus, did not perform a preliminary gastrostomy, but Neuhof,² from his experimental resection on dogs, concludes that it is safer to do

¹ *Ann. of Surg.*, 1921, lxxiv, 259.

² *Surg., Gyn. and Obst.*, 1922, i, 767.

this Very few resections in man have been successful, and most of these have been in the cervical region¹

Palliative gastrostomy for malignant disease should be performed neither too early nor too late Done at the right time, it prolongs life and makes it more endurable² performed while the patient can maintain his weight and strength without it makes him an invalid before his time, used too late, it is attended by a very high mortality and is most disappointing to everyone concerned It is more humane to give rectal infusions and sedatives in these later cases

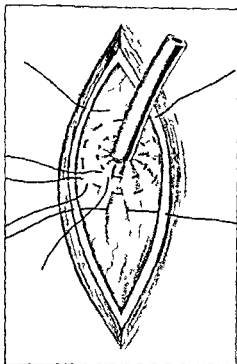


FIG. 62. Abbe's modification of Kader's method of gastrostomy. purse string and Paneth's sutures placed.

By carefully avoiding irritation of the structure by instruments and unsuitable food, and by the selection of nourishing but easily swallowed food, complete obstruction and serious loss of strength may be deferred for a long time Milk, milk and beaten up eggs, cream, butter, salad oil, sugar and sweets, jellies and soups are often suitable and successful if taken frequently and slowly

The best time for performing gastrostomy is when the patient is beginning to lose weight and strength rapidly in spite of all care in feeding and in spite of the aid of radium often valuable, and of dilatation and intubation in suitable cases under direct inspection through the cesophago scope It should be done early enough to allow healing to take place

¹ A. L. Turner, *Journal of Laryngology* 1920, p. 34

² F. J. Steward mentioned two patients who survived over five years and he advised early gastrostomy as the best palliative for these cases (*Surgical Section Royal Society of Medicine*, November, 1926) H. S. Souttar preferred intubation, using his special large metal tube

before the patient's vitality has been sapped by slow starvation, and before pulmonary complications have developed. Some late cases can be improved and made fit for operation by careful preparation and dieting with or without the aid of intubation.

OPERATION. (a) **Abbe's modification of Kader's method, also called Senn's operation.** Novocaine anæsthesia is used when a general anæsthetic, such as open ether with oxygen, is contra-indicated, as it is in most cases on account of the danger of pulmonary complications. Scopolamine and morphia, followed by regional and local anæsthesia with novocaine (0·5 per cent.), is sufficient and satisfactory and very much safer.

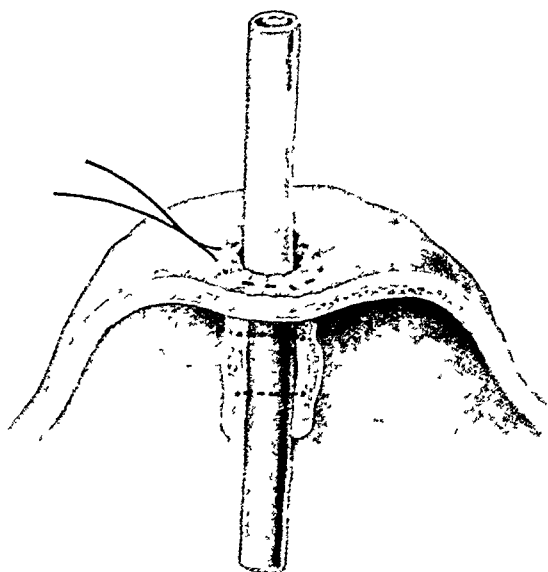


FIG. 63. Abbe's modification of Kader's method of gastrostomy. Section showing the effect of tying the purse-string sutures round the rubber-tube.

A vertical incision is made over the upper and outer third of the left rectus, extending from the level of the tip of the ensiform cartilage downwards for two and a-half inches. The sheath of the rectus is opened, the vertical fibres of this muscle are separated, and the posterior wall of its sheath is exposed. This and the peritoneum attached to it are incised together for about an inch and a-half. Two fingers are then introduced to feel for the stomach. As a rule the latter is contracted and lies high up under the left lobe of the liver and requires to be hooked downwards and forwards into the wound. Not infrequently the great omentum presents itself first, and it is easy, by seeking too low down, to draw up the colon. By drawing the great omentum and the colon downwards the stomach comes into view and is brought into the wound. An opening is made well away from the pylorus and about half-way between the lesser and greater

curvatures At this spot a small opening just large enough to admit a No 12 rubber catheter is made with a knife The catheter or tube of a similar size is introduced and passed into the stomach for two inches and is secured by a catgut suture piercing it and all the coats of the stomach A purse string sero-muscular suture of catgut is then inserted half an inch away from the tube which is pushed in by an assistant as the suture is tied just firmly enough to grip without compressing the tube Two or more similar sutures are introduced and tied with the result that an inverted cone projects into the stomach and around the tube A valve closely resembling that of an ink bottle is thus produced and seldom leaks even months after the operation The stomach is fixed to the parietal peritoneum by means of two catgut sutures which are passed one above and one below the tube through the posterior wall of the rectus sheath and parietal peritoneum and pick up a wide strip of the sero muscular coats of the stomach The incision is then closed in layers in the usual way and the tube is tied to one of the skin sutures to prevent its accidental withdrawal Passing a suture through the tube may lead to leakage of food with infection of the wound

Half a pint of milk or milk and egg is introduced at once into the stomach through the tube by the aid of a funnel After a week or ten days the tube becomes loosened and is replaced by another one which is closed by a clip and always kept in otherwise the track rapidly contracts and there may be difficulty and danger in reintroducing the tube especially in the early days Later on if the channel dilates too much and makes the tube loose the latter may be left out for a few hours occasionally

A dressing is applied until the wound is healed The skin sutures are removed at the end of ten days The patient is at first fed at frequent intervals Milk thickened in various ways is the best food but beef tea and soup may also be given if there is no diarrhoea The patient is also allowed to swallow water milk and other foods by the mouth if he is able or he may masticate very thoroughly some fish chicken or meat and feed himself with this through the gastrostomy funnel with considerable advantage and satisfaction In any case his mouth is frequently washed out with a solution of hydrogen peroxide or lemon and glycerine to keep the mouth clean and to slake thirst The teeth are also carefully cleaned they often need extraction before the operation

I prefer this operation to all others and it is especially valuable as it can be quickly performed on a very contracted stomach and without fear of leakage

(b) *Witzel's*¹ method The stomach having been drawn out a very small opening is made as in the previous operation a snugly fitting rubber tube or No 12 catheter introduced and fixed by means of a single catgut suture piercing it and all the coats of the stomach and then buried in the wall of the stomach for about two inches by a continuous sero muscular catgut suture two folds of the stomach wall being stitched over the tube as seen in Fig 65 The free end of the tube is then brought out of the wound while the area around it is stitched to the peritoneum on either side of the wound in the parietes The edges of the wound having been sutured the upper end of the tube may be closed with a clip and a sealed dressing applied Feeding by the stomach is begun

¹ *Centr f Chir* 1891 p 601

at once. Any leakage is prevented, not only by this oblique entrance of the tube into the stomach, but, as shown by a specimen obtained from a patient of Dr. Meyer, by the fact that Witzel's ingenious method of stitching the stomach walls over the tube causes a short artificial cone to protrude obliquely into the lumen of the stomach.¹ Mikulicz and Helferich have shown that, after a lapse of a few months, the oblique passage may become a direct one. Marwedel incises the sero-muscular coats and buries the tube between these coats and the mucous membrane. This takes a little more time, causes some bleeding, and is no more efficient than the simpler operation of Witzel.

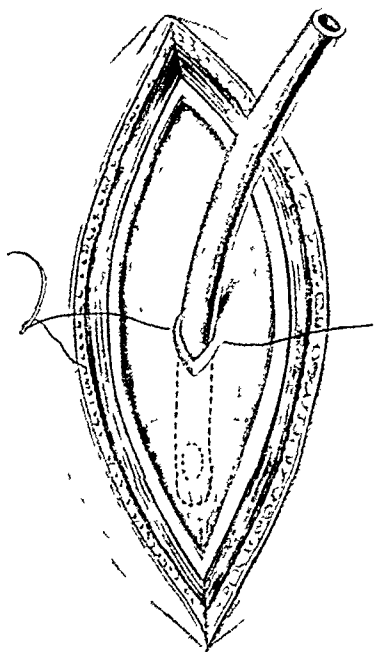


FIG. 64. Witzel's method of gastrostomy. Stitch to hold the tube to the edges of gastric opening.

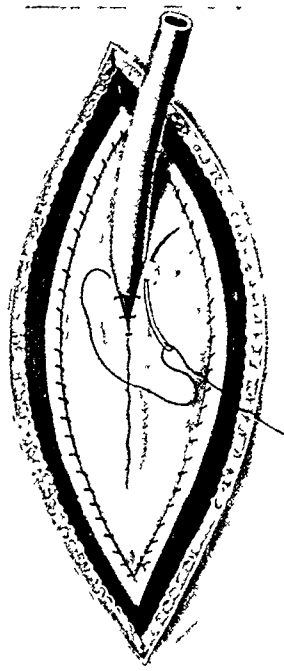


FIG. 65. Witzel's method of gastrostomy. The Cushing suture is shown burying the tube and gastric opening. The stomach has been sewn to the parietal peritoneum.

(3) **Frank's² method.** The peritoneum is opened either by an incision parallel with the costal cartilages or by one just within the linea semilunaris high up. The stomach having been drawn out, a long conical diverticulum of the anterior wall of the viscus is pulled well out of the wound, and the parietal peritoneum and the posterior layer of the sheath of the rectus are sutured round its base, care being taken not to constrict it too much (Fig. 66). A continuous suture is used, without perforating the mucous coat of the stomach. A small transverse incision is now made through the skin a little above the costal margin. The

¹ Another advantage of Witzel's method is illustrated by one of his cases. In a patient who had been operated upon for cicatricial stricture of the œsophagus, the fistula closed spontaneously within sixteen days after the stricture had been dilated and the tube removed from the stomach (Meyer).

² Albert, Ssabanjews-Frank.

skin between the two openings having been separated from the subjacent parts, the diverticulum of the stomach is drawn up under the skin and over the costal cartilages as far as the small skin incision to the edges of which its apex is united by a few sutures. A small opening is next made here into the stomach and the orifice fixed to the skin by one or two points of suture (Fig. 67). The lower part of the wound is then closed by a continuous suture. As a result the diverticulum of the stomach is drawn upwards its base is gripped by the muscular fibres of the rectus while a short upward-directed subcutaneous œsophagus is also formed. All escape of fluid is thus prevented and the patient

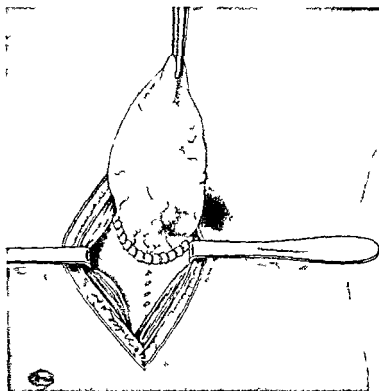


FIG. 67. Gastrostomy by Frank's method. (After Kocher.)

can be safely fed at once. This operation is not so easy as those already described and may be very difficult when the patient is very thin and the stomach drawn up and small. Moreover the channel tends to become direct so that leakage occurs in some cases after some months.

Mr T. P. Legg¹ draws out a cone of stomach two and a half inches long if possible and pulls this for one and a half inches to the left through the rectus muscle the fibres of which have been separated into anterior and posterior bundles. The base of the cone is fixed on its right border by about five stitches to the posterior wall of the rectus sheath and peritoneum and near its extremity it is secured by four sero-muscular sutures to the rectus sheath and to the skin wound which is an inch long and is

¹ *Lancet* 1905 i 1411

parallel to the rectus muscle fibres and the original wound. The latter is closed by means of salmorgut sutures, which include the anterior layer of the rectus sheath and some of the fibres of the muscle. A sealed dressing is applied to the wound. It is claimed that this operation provides a better sphincter for the fistula, owing to the greater length of cone which is surrounded by muscle fibres. In only one of the fifteen patients operated upon by Mr. Legg was there any leakage, and this only lasted a month and was probably due to the sloughing out of some of the stitches which occurred.

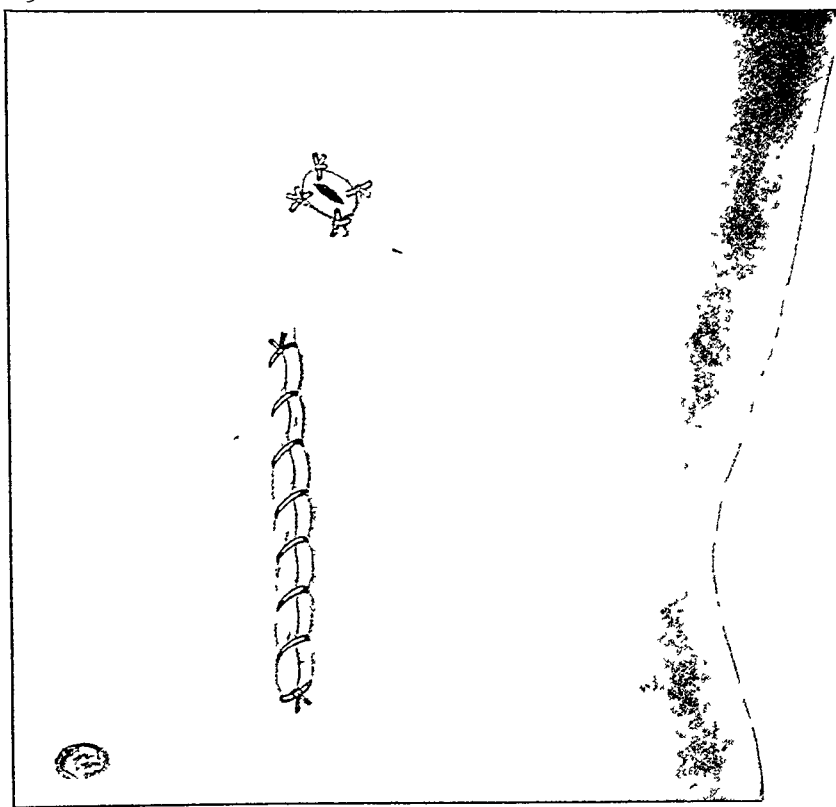


FIG 67 Gastrostomy by Frank's method completed (After Kocher.)

Causes of death after gastrostomy. (1) Inanition and exhaustion, the operation being performed too late. (2) Peritonitis, local or diffuse, from leakage of food and want of proper union or difficulties and damage in trying to reintroduce the tube after it has slipped out. (3) Extension of the disease to surrounding parts, *e.g.* trachea, bronchi, &c. (4) Lung affections, *e.g.*, pneumonia, due in part to the operation, *viz.*, the anæsthetic and enforced recumbency—and in part to the saliva, which cannot pass down the œsophagus, being drawn into the air-passages, either before or during the operation. Empyema, pulmonary embolism and chronic phthisis re-awakened by starvation are common. (5) Hæmorrhage, *e.g.* from ulceration into aorta or lung.

CHAPTER V

PERFORATION OF PEPTIC ULCERS

GASTRIC, duodenal gastro-jejunal or jejunal ulcers may perforate causing either local or general extravasation of the contents of the perforated viscus into the peritoneal cavity and giving rise to local or general peritonitis

The term 'perforation' should be reserved for these cases and not extended to adherent ulcers penetrating the adherent walls of the affected viscus without extravasation. Statistics especially in America are confused and vitiated by the loose use of this term

PERFORATION OF GASTRIC ULCER

Perforation of an acute gastric ulcer is a rare event but about 10 per cent of recognised chronic ulcers perforate. In the great majority there is a definite history of gastric symptoms for some months or weeks before the perforation. Frequently there have been more severe pain and discomfort for a few days before the sudden catastrophe. This is probably due to spreading of the ulcer causing inflammation of the peritoneum near it. Although ulcers are more common on the posterior surface of the stomach, those on the anterior wall are the most liable to perforate and to give rise to general peritonitis for posterior ulcers generally adhere to the posterior wall of the lesser sac before they penetrate. Thus out of 90 cases admitted for operation the perforation was on the anterior surface in 86 and on the posterior in 11. Perforation of gastric or duodenal ulcer is rare in women thus in Deaver and Pfeiffer's¹ series of 55 cases there was only one female and her ulcer was gastric. The large majority occur between the ages of twenty-five and forty-five. The perforation of a gastric ulcer may be *acute subacute or chronic*. A great deal depends on the size of the perforation the presence of previous adhesions and especially upon the amount of extravasation and therefore upon the amount of food in the stomach at the time of the perforation. Chronic perforation often leads to adhesion to neighbouring viscera such as the left lobe of the liver or the pancreas. Sometimes a chronic abscess forms generally in the lesser sac of the peritoneum or under the diaphragm. In subacute perforation only a small extravasation occurs at the time of the original perforation which is generally quite small. A localised abscess may then form between the liver and the anterior wall of the stomach. Later the perforation and extravasation may increase or a localised abscess enlarge and rupture into the general peritoneal cavity.

Acute Perforation. There is no doubt that recovery does sometimes take place without operation. I have seen several of these. One of my patients refused operation and recovered, to the surprise of everyone

¹ *Ann of Surg* 1921 LXXIII 449

concerned. Three months later she died of a second perforation.¹ But recovery without operation is exceedingly rare and is not to be depended upon. The successful treatment of this most serious catastrophe depends upon early, speedy and careful operation. This should be performed as soon as possible after the accident, for delay only leads to the escape of more of the gastric contents and to the spreading of peritonitis. With delay the peritonitis becomes more severe in character and paralytic distension of the bowel develops, rendering the operation very much more difficult and dangerous, and with every hour that is wasted the risk of death rapidly increases. The serious results of delay are well shown by the following table given by J. A. McCreery² :—

		Total cases.	Died.	Mortality.
Operations under 12 hours ...	...	17	1	6 per cent.
„ from 13-24 hours ...	...	5	3	60 „
„ „ 48 hours or more		2	2	100 „

The combined figures³ of Grey Turner and Norman Hodgson are even more striking, especially as regards the large number of cases, and the very low mortality of operations carried out within six hours of perforation.

PERFORATED GASTRIC AND DUODENAL ULCERS.

Combined figures of Mr. Grey Turner and Mr. Norman Hodgson.

No. of hours of perforation.	Total No.	Recoveries.	Deaths.	Percentage of Deaths.
Up to 6	62	61	1	1·61
7 „ 12	107	94	13	12·15
Over 12	79	53	26	32·77
Grand Total ...	248	208	40	16·12

All cases operated upon within twelve hours.

Total 169, with 14 deaths. 8·28 per cent.

Occasionally there is more than one perforation. Finney states⁴ that there is a second perforation in 20 per cent., but the coincidence is far less common in my experience. The possibility of it should never be forgotten, however, for it is easy to overlook a second perforation into the lesser sac. Gastric and duodenal ulcers sometimes perforate simultaneously.

Diagnosis. Here a warning is necessary that a great variety of conditions have been mistaken for perforated gastric ulcer, some of which may be mentioned : perforation of duodenal ulcer, ruptured tubal gestation, painful menstruation, perforative appendicitis, acute hæmorrhagic pancreatitis, thrombosis of the superior mesenteric vein, pneumonia, acute, irritant or ptomaine poisoning, acute dilatation of the stomach,

¹ In another instance a man was admitted into an infirmary in a semi-conscious state and was considered too ill for operation. About six weeks later an attempt was made to perform a gastro-enterostomy for the relief of pain, but this was said to be impossible on account of extensive and vascular adhesions. I operated upon him two years later and found extensive adhesions, including a thick and broad sling extending from an ulcer on the lesser curvature attached to the liver round the lower border of the stomach, which was thus drawn up, making the stomach hour-glass in shape. The division of this sling immediately restored the shape of the stomach.

² *Ann. of Surg.*, 1924, lxxix, 96.

³ Personal communication from Mr. Grey Turner of figures given in Hunterian Soc. Lect., year 1925 (not yet published).

⁴ *Ann. of Surg.*, July, 1900.

biliary colic and acute inflammation of the gall bladder. It will be noticed that most of these conditions require operative treatment so that a mistake is only serious as regards the site of the incision and the prognosis that can be given. In others an operation can do no harm but may do good but in pneumonia pleurisy menstruation &c the confusion of these with perforated gastric ulcer is serious. It may therefore be well to emphasise the leading and really important diagnostic features of perforation of a gastric ulcer. Too much stress cannot be laid on the history which is almost constant of a sudden onset of dreadful and intolerable pain especially in the epigastrium and later becoming general and even pelvic from trickling down of the escaping fluids. A sensation of something giving way as he is straining is often mentioned by the patient. Shock of a severe degree sometimes follows and is characteristic when seen but the patient is often better with normal pulse and temperature when the doctor arrives. The pulse rate usually falls immediately after the perforation and then gradually rises. A quickening pulse is of the gravest significance indicating peritonitis. The temperature usually falls at first and gradually rises. A contracted rigid tender abdomen is the most important of all and is found in spite of morphine administered for the relief of pain. Frequently local rigidity and tenderness indicate the site of the perforation. Later the abdomen becomes distended and tympanitic from paralytic distension and the liver dullness may be diminished from the escape of gas into the peritoneum. The respirations are shallow, catchy and hurried hence the mistake of diagnosing pneumonia in some cases. Vomiting occurs in about half the cases and the great majority give a history of previous indigestion or more serious gastric troubles.

Pneumonia and pleurisy should be always considered. A rub rales or disproportionately quick respiration rate with a rapidly rising temperature and flushed face suggest pneumonia.

Operation. The operation itself includes (i) Finding the perforation (ii) Successfully closing it (iii) Efficiently cleansing and draining the peritoneal sac—headings which will be taken separately. No operation calls for greater speed with care. When everything is absolutely ready and the patient anaesthetised an incision five inches long is made from near the right or left costo xiphoid angle to the level of the umbilicus and through the rectus sheath. The falciform ligament is thus avoided. When the peritoneum is opened an escape of odourless gas is not uncommon sometimes of fluid consisting partly of the last meal taken and partly of straw-coloured serous effusion from the irritation of the peritoneum. This is usually sterile in the early stages. If the fluid is bile stained the perforation is probably in the duodenum. If there is no such escape the outlook is so far more favourable as it may be hoped that as yet the extravasation is slight and limited to part only of the peritoneal sac.

(i) **Finding the Perforation.** This varies very much in difficulty. Sometimes the eye detects it at once when the stomach is drawn down wards and the edges of the wound are well retracted. Gas often bubbles and sizzles out of the perforation which is surrounded by a deposit of lymph. In a difficult case help may be obtained by tracing the direction in which the congestion of the stomach appears to be increasing and by watching the direction from which any flow that may be present is coming. The liver should be raised by an assistant and the stomach drawn down

wards and to the right, while the anterior surface and the lesser curvature are carefully examined with a good light. Adherent lymph or adhesions between the stomach and the liver may mark the site of the perforation and may require gentle separation before it is revealed. The perforation itself may be extremely small and thus easily hidden by any fold of the stomach; still more readily by lymph and adhesions. The greatest difficulty may be experienced with a perforation high up on the lesser curvature close to the œsophagus. In these cases it may be necessary and of great assistance to divide some of the fibres of the left rectus. Similarly, division of part of the right rectus may be necessary in some cases of perforated duodenal ulcer. Occasionally no perforation may be

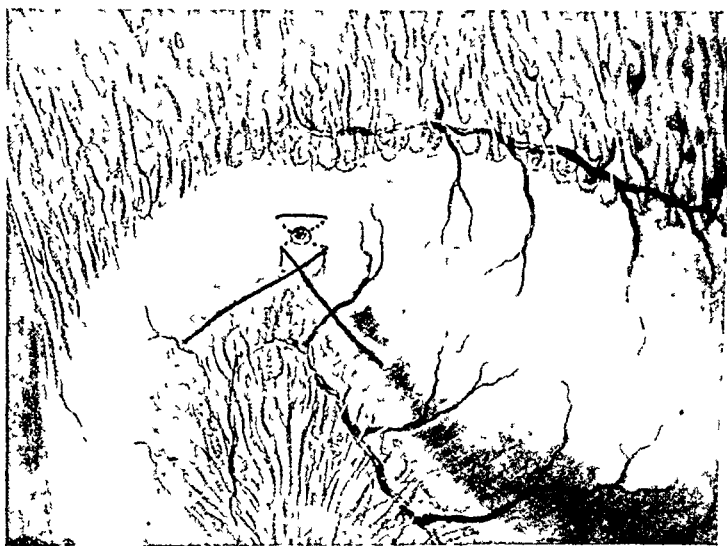


FIG. 68. Perforated duodenal ulcer closed by X-suture of catgut.

discovered until the lesser omentum is incised and the posterior surface of the stomach examined.

(ii) **Closing the Perforation.** If possible the perforated part of the stomach is brought well forwards into the wound and held there by the left hand. Gauze rolls fixed to the towels are introduced to absorb the effusion which often wells up and obstructs the view. Sometimes when the stomach is full and tense the stomach tube is passed by an assistant to empty it at once. A single perforating suture of catgut is passed to close the perforation and stop further leakage (see Fig. 68). This is invaginated by a continuous sero-muscular catgut suture which begins and ends well above and below the extremities of the perforation (see Fig. 69). When the ulcer is near the pylorus or in the duodenum it is particularly important to pass the sutures from side to side and not from above downwards, so as to avoid narrowing the outlet of the stomach. Fortunately it is easier to pass them in this direction than from above downwards. They should be inserted far enough from the margins of the perforation to ensure a safe hold and sufficient inversion of the serous surfaces. Occasionally it is very difficult or impossible to close the perforation very securely, but a flap of omentum may be sewn over the site of perforation. Then a wick

of thin soft rubber extending through a split rubber tube down to the perforation answers almost as well and possibly better in some cases¹

Perforation into the Lesser Sac of the Peritoneum. Fortunately, perforations of this surface are very rare, for they are difficult to discover and to close. In 5 out of 42 cases reported by Crisp English² the perforation was on the posterior wall close to the pylorus, and in 10 per cent of the 112 cases collected by Paterson³ the ulcers were on the posterior surface of the stomach. If the evidence of perforation is strong and nothing can be found on the anterior surface of the lesser curvature an opening is made in a bloodless part of the lesser omentum and the anterior wall of the stomach is invaginated and pushed upwards thus bringing the

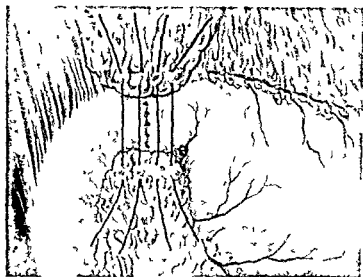


FIG. 69 Perforated duodenal ulcer. Serous catgut suture concealing the deep suture. omental flaps are used to cover the duodenum.

posterior surface into view. In nearly all these cases the perforation will be found near the pylorus.

Excision of the Ulcer. The excision of a perforated ulcer is not recommended, for it consumes much extra time, causes a good deal of additional hæmorrhage and converts the perforation into a large gap requiring numerous sutures to close it. Moreover, experience shows excision to be unnecessary for healing. The same objections can be used with even more force to primary resection of the ulcer-bearing area, a dangerous procedure advocated by some surgeons⁴.

Primary Gastro jejunostomy. Anterior gastro jejunostomy was first performed for perforated gastric ulcer by Braun⁵. The patient recovered and remained well for several years. It is now generally recognised that the posterior operation is far more efficient and it may be performed in selected cases, i.e. when the condition of the patient is good, the surgeon quick and capable, and the perforation at or near the pylorus or in the

¹ F. Corner, *Lancet*, 1913 i 600.

² *Medico-Chir Trans*, 1903 lxxxvii.

³ *Hunterian Lectures Lancet*, 1906 i 575.

⁴ Hromada and Newman *Surg Gynec and Obst*, July 1922.

⁵ *Centralblatt für Chirurgie*, Leipzig, 1897, p. 731.

duodenum, where closing of the perforation or the contraction of a large healing ulcer may lead to obstruction. About one-half of perforated ulcers are in this area, but only a few of them call for primary gastro-enterostomy. It may also be performed for very extensive ulceration in this neighbourhood and when there is more than one perforation or great difficulty in closing a perforation. This step has also been recommended in order to avoid immediate or subsequent dangers, or troubles from stenosis, persistence of ulceration, hæmorrhage, or secondary perforation of the same or of another ulcer. One of us has had to operate for jejunal ulcer in a case submitted to gastro-jejunosomy two years earlier for perforated duodenal ulcer. At the second operation the ulcer was excised and the short circuit abolished, there being neither stenosis nor ulceration of the duodenum at that time. The most important and, to my mind, sufficient objection is that many of these patients are not in a condition to stand a prolongation of the operation when they come for treatment. To save life it is usually enough to close the perforation, and the mortality is increased considerably by making a short circuit at the same time.¹ This is especially important, for this urgent operation has to be performed frequently by surgeons of little experience, whose main ambition should be to close the perforation and save life. If a gastro-jejunosomy becomes necessary it is safer in the large majority of cases to do it as a secondary operation. Experience shows that this is not often necessary if adequate medical treatment be adopted after the operation. It is obviously wrong to do it in all cases when only a few ever require it, even as a secondary operation. Mr. Grey Turner² found that over 50 per cent. of 120 cases traced for long periods remained quite well, and over 74 per cent. were greatly relieved and had not required a second operation; 15 per cent. had had another operation, and 1.66 per cent. required it; 8 died of some sequel of the original trouble. Stewart and Barber³ strongly support this view, and give strong clinical and experimental evidence in favour of it; they report twenty-four cases with twenty-two recoveries after simple suture and show that infolding ulcers near the pylorus rarely cause obstruction.

On the other hand, Deaver and Pfeiffer⁴ strongly advocate primary gastro-jejunosomy as a part of the treatment of perforated gastric and duodenal ulcers in the absence of severe shock or evident systemic toxæmia. In their series there were sixty-seven cases, operated upon within the previous fifteen years, with five deaths, a mortality of 7.5 per cent.; nine out of fifty-five were treated by suture only. In addition to these, seven patients were considered too late for operation. The average time of operation was about eight hours after perforation. The combined medical and surgical mortality of the seventy-four cases was 16 per cent. In London many of our patients come into hospital much later than eight hours after perforation and operation is hardly ever refused, even desperate cases sometimes recovering. Mr. Grey Turner's figures throw an interesting light upon this question.

¹ E. C. Cutler and F. C. Newton (*Boston Med. and Surg. Journ.*, 1923, cxxxviii, 789) found on analysing 486 published cases, the mortality of simple closure to be 19.4 per cent., and of closure and gastro-enterostomy 24.3 per cent.

² *Loc. supra cit.*

³ *Ann. of Surg.*, 1922, lxxv, 349.

⁴ *Ann. of Surg.*, 1921, lxxiii, 441.

THE QUESTION OF IMMEDIATE GASTRO ENTEROSTOMY

Total number of Operations for Ruptured Gastric and Duodenal Ulcers (General perforations) —

147 with 124 Recoveries and 23 Deaths	Per cent
Average hours of perforation	15 64
Cases with Primary Gastro-enterostomy —	
26 with 20 Recoveries and 6 Deaths	23 08
Average hours of perforation	10 8
Cases without Primary Gastro enterostomy —	
98 with 81 Recoveries and 17 Deaths	17 34
Average hours of perforation	13 1

Primary Pyloroplasty was performed in twelve cases (four gastric and eight duodenal) but in five of these there was recurrence of symptoms two having recurrent perforations

Later on when abdominal symptoms develop and persist in spite of medical treatment the patient should be very carefully examined before advising and deciding upon the most appropriate radical operation for gastro jejunostomy is by no means always the best, and this is an important argument against doing it at the time of the emergency operation. Particular attention should be paid to the possibility of appendix dyspepsia and in all cases the stomach should be examined by the bismuth and X ray method before concluding that there is stenosis or persistent ulceration. When the symptoms justify an operation it should always commence as a thorough exploration. The appendix should always be removed if time permits

Washing out the stomach When the stomach is very full at the time of the operation it is a distinct advantage to wash it out directly the perforation has been closed for it makes the patient much more comfortable, allays vomiting promotes healing and allows earlier feeding

(iii) **Cleansing the Peritoneal Sac** Though most stress has been laid upon the point of efficient suturing of the perforation, there is no doubt that this one is important

In the majority of cases where the extravasation is limited or clear and sterile, as it is in early cases it is wiser not to irrigate as this may do more harm than good. The soiled portion of the peritoneum should be gently cleansed with sterile swabs or gauze rolls. As it is not always easy to judge the extent of the soiling it is wise to examine the kidney pouches, sub diaphragmatic spaces and the pelvis in every case

Drainage Before closing the abdominal wound the question of drainage will arise. The necessity for this largely depends upon the particular conditions found at the operation. If the case has been operated upon early and if the amount of extravasation is small or non purulent, it is sufficient to cleanse the soiled area the abdomen being closed without drainage. In a few doubtful and late cases however, temporary drainage is safer. If there is late peritonitis implicating practically the whole abdominal cavity, a short tube should be inserted through a small incision above the pubes. The exploratory incision is usually closed in layers. No drainage tube is passed near the perforation, but in some bad cases one is directed towards the right kidney pouch

The two following cases are good examples of this condition. The first was a large perforation near the pylorus treated after five hours. The second had a perforation of an ulcer near the œsophagus leading to extravasation to the left kidney pouch spreading to the left iliac fossa and pelvis. This condition can be easily overlooked when the usual incision is made to the right of the middle line. The details of treatment have improved in the fifteen years which have passed since these patients were admitted.

The first case was that of a young man of 23 who was walking home hungry over the Tower Bridge when he was suddenly seized with such a severe pain in his abdomen that he was obliged to lie down on the pavement. He was promptly brought up in a collapsed condition to Guy's Hospital. His condition soon improved, however, and then he refused operation because he could not be persuaded of his peril. He wished to consult his mother first, but she lived far away. At last he consented, when his condition was compared with that of a drowning man who declined to grasp a rope until he had obtained his mother's sanction. The patient gave a history of an attack of appendicitis. The pain, tenderness, and rigidity in the present illness was more marked on the right side near the appendix, and there was impaired resonance in the right loin. An incision was made through the right rectus at a higher level than is adopted for appendicular cases, because it was felt that the very sudden and severe onset was very suggestive of perforation of the stomach. Turbid serum was found in the iliac fossa, but the appendix was not diseased; the incision was enlarged upwards, and a good-sized round gastric perforation was found near the pylorus and closed with Lembert sutures. On account of the extensive extravasation, free irrigation was employed, followed by the insertion of cigarette drains, one between the stomach and the liver and another in the right kidney pouch. The patient was quite well nine months later.

The second patient was a girl of 19, who had suffered severely from indigestion for six months. She also gave a history of a sudden and agonising pain, but it was situated chiefly in the left hypochondrium. She was given a dose of morphia to enable her to travel in comparative comfort from a fever hospital to Guy's. An incision made through the right rectus as high up as possible disclosed a collection of sero-pus and gastric contents between the liver and the stomach and also travelling down towards the left kidney pouch. A perforation was discovered on the anterior surface close to the lesser curvature, very near the cardiac orifice. The stomach was drawn downwards and to the right, and an assistant held the left costal margin upwards, while another retracted the liver; and after much trouble the perforation was closed by inversion, and a loose flap of fatty lesser omentum was turned down and secured over the sutures. The ulcer was a chronic one of large size with thick walls, so that inversion was not easy, apart from the depth. Irrigation was not adopted because the extent of extravasation was not great, and dry swabbing was used instead. A cigarette drain was left in front of the stomach near the perforation. The patient recovered.

Causes of failure.—(1) *Acute septicæmia from peritonitis* existing before, and not cured by, the operation. This has been the most frequent cause of death.

(2) *Failure to find or to close the perforation.*

(3) *Shock* of the perforation and operation. This can be largely prevented or corrected.

(4) *Sub-diaphragmatic abscess* causing septicæmia or leading to pulmonary complications.

(5) *A second perforation.* This is stated by Finney to be present in 20 per cent. of the cases, and a careful search should therefore always be made for a second ulcer. Again, a second perforation may take place after the operation, for when the ulcer is very large another spot may give

way probably from softening set up by the local inflammation due to suturing

(6) *Hæmorrhage from the same or another gastric or from a duodenal ulcer*

B Subacute Localised Abscess due to Perforation of a Gastric Ulcer
The perforation may be very small or the stomach may be empty at the time of the perforation so that only a comparatively small extravasation occurs which may be walled off by adhesions for a time. I operated on a case of this kind under considerable difficulties with Dr Gardiner at Dunmow. The perforation had occurred about forty eight hours before the operation at which a collection of pus was found between the liver, the anterior surface of the stomach the abdominal wall and the upper half of the great omentum. A small perforation was found near the pylorus this was closed and the pus was mopped up and drainage employed. The patient was well for many years but developed pyloric stenosis fifteen years later.

C Chronic Abscess due to Perforation of a Gastric Ulcer Instead of sudden perforation with escape of the contents of the stomach into the general peritoneal cavity the perforation here is associated with the formation of adhesions and the production of a localised abscess. This may be brought about in several ways. In some cases the base of the ulcer becomes adherent to a viscus liver spleen or pancreas—subsequent perforation giving rise to an abscess which slowly burrows first into and then beyond the viscus involved. In other cases the perforation is into the lesser sac or is preceded by a plastic peritonitis resulting in the formation of adhesions which thus limit the diffusion of gastric contents when perforation occurs. Again the leakage of gastric contents may at first only take place quite slowly owing either to the small size of the perforation to the stomach being empty at the time or to the perforation taking place during the night. The abscess so produced is in most instances of the sub phrenic variety (p. 87).

The Mortality of Perforation of a Gastric Ulcer There has been a progressive improvement in the results of operations for perforating gastric ulcers due to earlier operation and better methods. The mortality should not be over 20 per cent and in some series it has been below 10 per cent.

PERFORATION OF DUODENAL ULCER

This occurs much more frequently in men than in women. The symptoms of this condition differ to some extent from those of perforating gastric ulcer because of the site of the perforation in the first part of the duodenum and within the right kidney pouch of the peritoneum in practically every case. Many ulcers formerly thought to be pyloric were really duodenal i.e. situated to the right of the pylorus and pyloric vein.

The late Mr. Rutherford Morison described and drew attention to the importance of this pouch in 1894¹

Sir Berkeley Moynihan² in a valuable paper pointed out the direction in which extravasated fluid travelled from it towards the appendix giving rise to symptoms closely simulating those of appendicitis. In the 51 cases

¹ *Brit. Med. Journ.* 1894 i. 968

² *Lancet* 1901 ii. 903

collected by him a correct diagnosis was only made in 2, whereas the primary incision was made over the appendix in 19 cases. Mr. Maynard Smith¹ gives an interesting account of an experimental and clinical study of the anatomy and pathology of the kidney pouch and its bearing on perforating duodenal ulcer. The limits of the pouch are: *in front*, the lower surface of the right lobe of the liver and the hepatic flexure of the colon; *behind*, the peritoneum covering, the right kidney and the posterior abdominal wall which slopes backwards and outwards from the spine, determining the flow of liquid away from the foramen of Winslow which, with the duodenum, forms the inner boundary. The abdominal wall forms the outer limit; above, the pouch extends behind, to the right and in front of the right lobe of the liver. The lower boundary is less complete, consisting partly of the beginning of the transverse mesocolon, as it stretches back to the kidney and second part of the duodenum; to the outer side of this a leak may occur. Maynard Smith found that liquid which had been introduced into the kidney pouch through a perforation in the duodenum overflowed downwards along the outer border of the colon towards and ultimately over the pelvic brim, and, in cases with short ascending mesocolon, the fluid passed forwards over the front of the ascending colon near the liver and then passed downwards towards the lower end of the ileum and cæcum, the obliquity of the mesentery and the prominence of the spine preventing any flow towards the left until the pelvis had been flooded.²

These facts have an important bearing upon the diagnosis and treatment of perforating duodenal ulcer. Such perforations may be roughly divided into acute, subacute and chronic.

In the acute a large ulcer may tear away from adhesions and a copious extravasation may occur, leading to a diffuse peritonitis. In other cases the extravasation may be small in amount and become limited temporarily or permanently to the kidney pouch.

Symptoms and Signs. These are similar to the symptoms and signs of perforation of gastric ulcer, but the previous history, the initial symptoms and localising signs are most marked in the right hypochondrium and right flank, and the appendical region often becomes immobile, dull and tender, so that appendicitis is often diagnosed. This condition may be distinguished from appendicitis by *a careful study of all the available evidence; the history of a very sudden and severe onset is against appendicitis*, although a latent abscess may occasionally burst and give rise to very sudden symptoms. Most surgeons settle the question at once by opening the abdomen. This is the safest plan for both diseases. The diagnosis is rendered more difficult because the appendix may be placed higher than usual and, moreover, appendicitis and perforation of a gastric or duodenal ulcer coexist occasionally or follow one another very closely.³

¹ *Ibid.*, 1906, i, 895.

² Russell, Wallace, and Box (*St. Thomas's Hosp. Reports*, 1897) made some similar observations on the anatomical importance of the "peritoneal watersheds."

³ Warren Low, Bolton Carter, Lediard and Sedgwick, Watson Cheyne, quoted by Maynard Smith (*loc. supra cit.*), and Graham (*Ann. of Surg.*, 1904, xl, 447). Gutch (*Lancet*, 1906, i, 1243) records the case of a man of 36 who died from hæmorrhage from and perforation of an acute ulcer of the duodenum; death occurred within two days of an operation for the treatment of appendicitis with abscess formation. A concretion was found in the appendix, but the latter could not be removed.

A mistaken diagnosis of intestinal obstruction has been made, and several cases are mentioned by Lockwood¹ The rigidity, fixation tenderness (especially on the right side) and other signs of early peritonitis and the incompleteness of the constipation may serve to prevent this mistake Leucocytosis may also help

It is almost impossible to tell the difference between perforation of the duodenum and a similar condition of the pyloric region of the stomach, for the fluid may pass into the kidney pouch and travel down the right flank exactly as in duodenal ulcer It must not be forgotten that some acute diseases that may be confounded with gastric perforation may likewise be mistaken for perforating duodenal ulcer (*vide supra*) In one case under my care the patient had been thought to be suffering from lead colic and had been treated with purgatives for twenty four hours before I saw him and found a quantity of castor oil in the abdomen

Operation This is similar to that for perforated gastric ulcer

The ulcer is nearly always met with on the anterior aspect of the first part of the duodenum Sometimes it is on the posterior surface as in one of Mr Lockwood's cases in which the necropsy showed that it would not have been seen at an abdominal exploration When local congestion and swelling point to posterior perforation this may be found and closed after incising the parietal peritoneum and mobilising the duodenum after Kocher's method (p. 199)

The perforation should be closed by means of one or two layers of sutures as in the treatment of perforated gastric ulcer It is especially important here to pass the sutures in the same direction as the axis of the bowel to avoid narrowing of the canal when they are tied An omental graft may be used to fortify the line of suture and in some cases, where it is not possible to close the perforation or this involves great narrowing of the lumen a primary gastro jejunostomy may be necessary but it should not be done in other cases unless the condition of the patient is good In most cases the patient cannot stand a prolongation of the operation and it is better to defer gastro jejunostomy until a later date and until symptoms indicate the need of it

Prognosis Only 7 of Moynihan's collection of 51 cases recovered and the first was the one operated upon by the late Mr Dunn at Guy's Hospital in 1896 Later Moynihan recorded² 56 cases with 11 deaths A short curving operation was adopted in 44 cases

In 1910 58 operations were performed at 14 London hospitals with a mortality of 39 per cent³

A. H. Southam⁴ had no deaths in 34 cases operated upon within 24 hours but 2 deaths in 6 cases operated on later

J. A. McCreery⁵ had 1 death in 10 cases of perforated duodenal ulcer

PERFORATION OF JEJUNAL AND GASTRO-JEJUNAL ULCERS

After about 3 per cent of gastro jejunostomies for non malignant disease one or more ulcers may develop either at the anastomosis (gastro jejunal) or in the jejunum usually just below it (jejunal) About one third

¹ *Lancet* 1904 ii 968

² *Abdominal Operations* 1906 i 241

³ *Paterson's Gastric Surgery* 1913.

⁴ *Brit. Med. Journ.* 1909 i 506

⁵ *Ann. of Surg.* 1904 lxxix 96

are gastro-jejunal and two-thirds jejunal. The efferent limb of the jejunum is the one most commonly affected.

This ulceration is very difficult to cure and is apt to lead to perforation at any time from a few days to several years after gastro-jejunostomy. As a rule, this catastrophe is preceded by a normal interval without any digestive symptoms for months or several years. Then there is a period of indigestion with symptoms simulating those of duodenal ulcer except that the pain, which the patient often describes as burning, is usually situated to the left of the middle line about the level of the umbilicus. Further, its relation to food is far less striking, although it is generally aggravated by solid food, so that the patient limits his diet, loses flesh and becomes anæmic. Sometimes the pain is relieved by food, but it comes on again in an hour or two. Usually there are nausea and loss of appetite and occasionally vomiting and even hæmatemesis with signs of dilatation of the stomach. There are often tenderness and resistance to the left of the umbilicus, and there may be an induration here due to plastic peritonitis with adhesion to the parietes, and even a cutaneous fistula may form. At any time signs of a grave form of perforative peritonitis may rapidly develop. In another class of case there is no period of indigestion, but the patient, who appears to be in perfect health, is suddenly seized with violent abdominal pain and all the signs of spreading peritonitis soon develop.

Operation. In the main this is the same as that already described for perforated gastric ulcer, but as the patient is usually in a worse condition even more speed, skill and judgment are required to ensure success. The old scar is avoided on account of adhesions and, moreover, a wound lower down and to the left of the middle line gives more direct access. The middle third of the left rectus is split or displaced outwards. Yellowish sero-pus and gas escape. Gauze rolls are passed into the loins and pelvis and secured to the towels. These absorb the effusion while the perforation is sought and closed. When the gastro-jejunostomy is anterior (as it often is in these perforative cases) the limbs of the jejunal loop are at once seen running almost vertically downwards from the stomach, and a perforation is seen either at or just below the anastomosis; sometimes it is near the entero-anastomosis. It is closed with two catgut stitches, one penetrating and the other sero-muscular. When the gastro-jejunostomy is posterior, the omentum and transverse colon may be so adherent as to be difficult to bring forwards and upwards out of the way. The adhesions are separated by gauze dissection and all bleeding vessels tied. The condition of the patient rarely allows a radical operation at this stage, but the size of the anastomotic opening and pylorus should be ascertained, so that some forecast of the future may be made. Sometimes there may be time to enlarge the gastro-jejunostomy opening after Finney's method of enlarging the pylorus. The peritoneal cavity is cleansed by gauze rolls as already mentioned, but, if the extravasation be extensive, lavage may be chosen. The wound is completely closed, but in most cases drainage is established through a stab wound above the pubis. Through this a split rubber tube is passed.

Every attempt is made to cure the ulcer by careful medical treatment. This consists essentially of prolonged rest in bed on bland albuminous and fatty foods with alkalies to neutralise the over-acid gastric juice.

If this full a radical operation must be undertaken when the condition of the patient allows

The following case illustrates some of the difficulties that may be met

Anterior Gastro-jejunostomy, Perforated Jejunal Ulcer, Suture and Drainage Later detachment of Jejunum, Excision of Ulcer, Gastro duodenostomy Recovery

E R male aged 30 June 1905 Anterior gastro enterostomy, elsewhere for pyloric obstruction Relief for four and a half years Then pain in abdomen to left of navel partly relieved by food In April 1910 sudden very severe pain

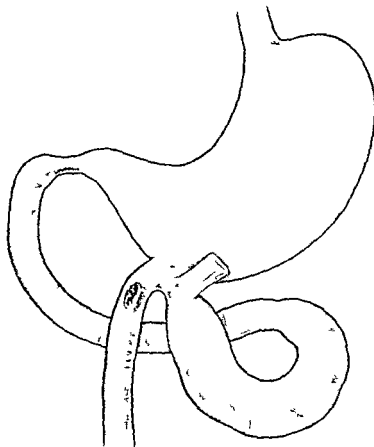


FIG. 0 Perforated jejunal ulcer The gastro jejunostomy was anterior and the jejunal loop had dilated the stoma had almost closed

between shoulders as if a knife had been stuck in Could not stand up straight Got home with great difficulty and was in bed for two days Since then a heavy sort of pain like a stone on the left side towards navel Later pain got more severe but was relieved by food for a time Appetite fair Bowels very free Wasted For three weeks before perforation pain unusually severe

On September 2 1910 at 6.30 P.M. during micturition suddenly felt a terrible burning and sharp aching pain running downwards from navel to pubes Pain not relieved by morphia Patient admitted to Guy's Hospital seven hours after perforation and abdomen opened half an hour later Large amount of sero-purulent sanguinous fluid and gas escaped The pelvis both flanks and the sub-diaphrag

matic space on both sides were full of this sero-purulent liquid. Anterior gastro-jejunostomy without entero-anastomosis found; proximal limb of jejunum greatly dilated and hypertrophied. Dense adhesion between its gastric end and parietes, indicating an old perforation in April. Large perforation in distal limb 1 in. below gastro-jejunal opening (see Fig. 70). The latter only $\frac{3}{4}$ of an inch in diameter. Perforation closed, abdomen washed out, and tube inserted at lower angle of wound. Patient did well while in hospital, but soon afterwards symptoms returned in spite of continued medical treatment. Readmitted once for prolonged medical treatment. Improved a great deal, but had not been out many days before old pain and vomiting returned. Burning pain and feeling of bursting.

Operation, May, 1911: Jejunal ulcer now adherent to the liver, detached, and thus opened. Pylorus almost occluded and adherent high up and far back. Jejunum then detached from stomach. Ulceration around stoma and jejunal ulcer excised. Large jejunal wound closed transversely without narrowing of lumen. Gastric wound enlarged up and to the right for 3 in., and joined to similar opening made in front of first and second parts of mobilised duodenum. Good recovery. Well for ten years, then pyorrhœa, symptoms of duodenal ulceration abating after three months' medical treatment. The patient remained well for four years, but developed a gastric ulcer in 1926.

Early in 1923 Mr. Grant Massie,¹ acting for me in a similar case, successfully closed two perforations of the jejunum following anterior gastro-jejunostomy elsewhere two years earlier. One of these perforations was in the proximal limb of the jejunum. I subsequently excised two ulcers and abolished the gastro-jejunostomy, for there was at that time neither ulceration nor stenosis of the pylorus or duodenum. The man did very well and has remained well over two years.

Mr. Grant Massie studied 36 recorded cases in addition to his own. The large majority (75 per cent.) of the perforating ulcers were jejunal, being less protected than those at the anastomosis. Twenty-two of the thirty-seven patients died, so that the mortality is very high, nearly 60 per cent.

Radical operations for these conditions will be discussed with the complications of gastro-jejunostomy.

¹ *Guy's Hospital Reports*, 1924, lxxiv, 70

CHAPTER VI

CHRONIC GASTRIC AND DUODENAL ULCER

GASTRIC ULCER

No responsible surgeon would suggest operating for *acute* ulcer apart from perforation or severe recurring hæmorrhage which fortunately rarely complicate acute gastric ulceration. The acute ulcer usually heals under proper medical treatment which should be carried out patiently and very thoroughly in order to prevent the ulcer becoming large deep chronic callous and almost intractable without operation. This is the surest way of preventing the grave complications and sequelæ of gastric ulcer.

On the other hand *chronic* gastric ulcer is very difficult to cure medically and frequently calls for operation. Physicians and surgeons agree that early operation offers the best and often the only hope for patients suffering from such complications as perforation, pyloric stenosis, hour glass contraction and recurring hæmorrhage but they do not agree about the treatment of simple uncomplicated chronic gastric ulcer. Some physicians say that most chronic ulcers can be cured medically whereas not a few failures follow surgery. Some surgeons maintain that no *true* chronic ulcer ever heals under medical treatment although the symptoms may disappear for long or short intervals. This is the natural history of the disease with or without treatment. It is unfortunate that the older statistics of the results of medical treatment are almost worthless owing to the difficulty of diagnosis before the radiologist succeeded in demonstrating the presence or absence of gastric ulcer. There is no certainty of diagnosis unless the ulcer can be (1) repeatedly shown by the radiologist or (2) seen and felt at operation or at post mortem examination. Until recently it was confidently believed that gastric ulcer was more common in women than in men now it is known that it is at least twice as common in men. Moreover gastric ulcer was long thought to be more common than duodenal ulcer whereas the contrary has been proved in recent years. Therefore it is clear that many of the gastric ulcers supposed to have been cured medically never did in fact exist. Most of the chlorotic young women who were admitted to hospital for hæmatemesis never had a chronic gastric ulcer. Sir William Hale White¹ in 1906 drew attention to this important fact and called this type of hæmatemesis *gastrostaxis*. Accurate statistics of the ultimate results of the medical treatment of true chronic gastric ulcer are badly needed. From a study of 6400 operations for gastric and duodenal ulcer at the Mayo Clinic Eusterman² concluded that the end results of surgical treatment are highly favourable only 228 secondary operations having been required. Satisfactory results were obtained in 70 to 80 per cent. Over 10 per cent were relieved but not cured. About 10 per cent were no better and some worse after operation and these are very difficult to treat.

¹ *Lancet* 1906 i 1189

² *Collected Papers of the Mayo Clinic* 1911 x 49

About 2,000 deaths occur every year in England and Wales from gastric ulcer.¹ About 15 per cent. of those admitted to hospital died mostly from perforation and hæmorrhage.² Apart from death, chronic ulceration often causes severe pain and misery, saps the vitality and seriously reduces the earning capacity of a great many patients, some of whom become chronic invalids. Recurrence of symptoms occurs in a large majority of cases which have been discharged, apparently cured by medical treatment. Many coming to the surgeon for operation have been "cured" medically several times, often in different hospitals. Some improvement in the results may be obtained by earlier, more thorough and more prolonged medical treatment, but this is very difficult to adopt for poor patients. In all cases sources of septic absorption in the mouth, throat, nose and elsewhere should be sought and treated, special attention being paid to the teeth and alveoli, which should be radiographed; suppuration round the roots of apparently healthy teeth is a common source of embolic infection of the stomach and duodenum. Whenever possible, six weeks' rest on a careful diet with suitable alkaline treatment should be tried. When the symptoms either do not abate or recur after this an operation should be advised. In private practice, under favourable circumstances, medical treatment may be given a longer trial, if the patient is not wasting. In many cases, especially when proper medical treatment is impracticable or the patient does not improve under it, an operation should be undertaken earlier. Surely it is better, safer and far easier to operate before the ulcer becomes large, callous, adherent and thick-walled, before dangerous complications develop and before malignant disease supervenes.³ The risk of operation is small (say, 4 per cent.) compared with the danger of waiting (say, 12 per cent.), and the prospect of cure of a chronic ulcer from early operation is infinitely greater than from the most careful medical treatment. The earlier the operation the easier and less risky is it likely to be. MacCarty,⁴ from an experience of more than 1,400 gastric specimens, says that the association of cancer with chronic gastric ulcer is so frequent that if he had a chronic gastric ulcer he would always consider the possibility of cancer being present and would not temporise with it. Referring to the great difficulty of telling whether a chronic ulcer is innocent or malignant, he writes: "Whether or not the members of the profession agree on the therapy to be applied to chronic gastric ulcer, it is certain that surgery offers the only means, with our present knowledge, of making the correct diagnosis, and certainly we have no medical or dietary method of treating cancer." In 29 per cent. of 733 excised chronic gastric ulcers, MacCarty needed the microscope to settle the diagnosis between simple ulcer and carcinoma. An ulcer larger than 2.5 cm. in diameter is almost always carcinomatous.

When the patient loses flesh in spite of careful medical treatment and there is anorexia and low acidity, exploration is to be undertaken without delay, for *malignant disease is probable*, and this can only be treated radically by early operation. Another important reason for exploring the abdomen, when medical treatment has been tried for a reasonable time in

¹ Report of the Registrar-General, 1923.

² Hawkins, *Med.-Chir. Trans.*, 1906, xc, 268; and Bulstrode, *Chir. Soc. Trans.*, 1903, 986.

³ *Collected Papers of the Mayo Clinic*, 1922, xiv, 95.

⁴ *Ibid.*, p. 99.

vain, is that, in a good proportion of cases, the diagnosis is found upon exploration to be incorrect, chronic appendicitis or gall stones often being found. For these the orthodox medical treatment of gastric ulcer is useless, whereas a radical operation offers a splendid and immediate prospect of cure. In other cases early malignant disease of the stomach or bowel may be discovered while yet amenable to radical treatment.

While much may be learnt from the history and from observation of the patient, it must be admitted that it is difficult to be sure of the diagnosis of gastric ulcer apart from such complications as pyloric obstruction. Severe pain in the epigastrium or left hypochondrium and below the left scapula, coming on immediately or within an hour after meals and often relieved by vomiting, is suggestive. Definite and constant deep tenderness and cutaneous hyperæsthesia in those regions are more reliable. X-ray examination by experts is getting more and more satisfactory, a crater or "niche" on the lesser curvature and a spasmodic "notch" on the greater being nearly always (but not invariably) demonstrated when a gastric ulcer is present. Increase of pain and tenderness often precedes perforation. Hæmatemesis only takes place in a quarter of the cases but occult blood in the stools on a meat free diet is very common and significant.

In spite of all care, however the diagnosis often remains uncertain until the abdomen is opened when an accurate diagnosis can be made within a few minutes and appropriate treatment immediately adopted. Before suggesting an exploration every care should be taken by means of the usual careful systematic examinations to exclude the possibility of mistaking nervous renal pulmonary or other disease for gastric ulcer.

The successful treatment of chronic gastric ulcer depends on a careful combination of medical and surgical treatment upon careful preparation and treatment before the operation, on careful selection and skilful performance of the most suitable operation in each individual case, and on the most careful and prolonged after treatment. "Consistent medical management is often superior to poor surgery" (Eusterman).

Choice of Operation In every case the operation should commence as a thorough but rapid exploration of the whole abdomen to confirm, complete or alter the clinical diagnosis. Appendicitis, cholecystitis or other disease is treated if necessary and wise, the stomach and duodenum are very carefully inspected and palpated, if there is any dilatation of the first or second part of the latter the third part is examined for duodenal ileus. If no ulcer can be seen or felt and demonstrated no gastric operation should on any account be performed, an ulcer too small to be discovered without opening the stomach will heal under proper medical treatment.

If a definite ulcer is found the choice of operation should be made with the greatest care, having regard to its suitability and its probable results both immediate and remote. It is certain that the same operation is not suitable for every case and that the best choice can be made only after careful consideration of all the facts. It is vital to decide whether the ulcer is gastric or duodenal, for only the former carries the risk of malignancy, therefore the relation of the ulcer to the pyloric vein and the pylorus is to be carefully ascertained. The fear of present or future malignancy

makes it desirable to excise a gastric ulcer whenever possible without undue risk. The following operations will be discussed briefly :—

- 1.—Gastro-jejunostomy.
- 2.—Gastro-duodenostomy (including Finney's operation).
- 3.—Excision of the ulcer
 - (a) by cautery ;
 - (b) by knife.
- 4.—Excision and gastro-enterostomy.
- 5.—Sleeve resection.
- 6.—Partial gastrectomy.
- 7.—Jejunostomy.

(1) **Gastro-jejunostomy.** For ulceration and especially for stenosis of the pylorus or duodenum this operation is very successful, being attended by a small risk (1 per cent.) and followed by a permanent cure in over 90 per cent. of the cases. In a few cases, however, carcinoma has either been overlooked or has supervened with fatal result. For ulcers in the body of the stomach, well away from the pylorus, it has not been so successful, but in my experience it has usually brought immediate relief of symptoms ; the severe pain commonly associated with an ulcer at or near the lesser curvature ceases, so that the patient can eat better and usually gains weight. This success is due to cessation of distension and spasm of the stomach and pylorus, for the new aperture, if large enough and well-placed, provides a readier exit for the food, so that the ulcer is no longer irritated and stretched : radiographic examinations before and after operation support this statement. These benefits are gained at the small risk of gastro-jejunostomy. In some cases this or jejunostomy is the only reasonably safe operation, for the ulcer may be so large, inaccessible, adherent or invading as to be irremovable without grave risk. During the seven years preceding 1921 gastro-jejunostomy was a part of the surgical management in 82 per cent. of the operations for gastric ulcer in the Mayo Clinic, excluding gastric resections.¹

The disadvantages of gastro-jejunostomy used alone are :—

(a) that a callous chronic ulcer may not heal in spite of the relief of symptoms, or healing may be long delayed in spite of appropriate treatment.

(b) that occasionally perforation or hæmorrhage may ensue in spite of gastro-jejunostomy. The risk of these complications is almost eliminated by adding excision of the ulcer.

(c) that it is impossible to be sure at the operation whether the ulcer is innocent or malignant ; it is often impracticable to get a reliable specimen for examination, for careful histological examination of many sections from different parts of the ulcer is necessary to decide this important point. Out of 1,280 patients with gastric ulcer operated on in the Mayo Clinic² during the 15 years before January, 1921, there were 195 deaths following satisfactory recovery from the operation and at least 75 of these were due to carcinoma either pre-existing or following the operation. "The evidence, however, indicates that in almost all of these deaths from cancer the lesion had already undergone malignant changes at the time of the operation."

¹ D. C. Balfour, *Collected Papers of the Mayo Clinic*, 1921, viii, 72.

² D. C. Balfour, *Ann. of Surg.*, 1922, lxxvi, 405.

This experience is common to other surgeons¹ and points to the need for excision of the ulcer, whenever possible, even at considerable increase of the immediate risk. Balfour² concludes that the subsequent death-rate of patients operated on for benign gastric ulcer, instead of being three times the death-rate of the general population of similar age and sex as he previously estimated,³ is really less than twice that rate.

(2) Either gastro duodenostomy or Finney's operation combined with excision of the ulcer may be useful in the treatment of selected cases of gastric ulcer, and preferable to gastro-jejunostomy because it avoids all risk of "vicious circle" and jejunal ulceration. When the ulcer is anterior and near the pylorus it may be successfully excised while doing Finney's operation of gastro-duodenostomy. The main objections to these operations, however, are that they are more difficult and less safe than gastro-jejunostomy and, above all, that they do not drain the stomach so well.

(3) (a) **Cautery Excision.** This appears to be safer, less extensive, and yet more radical than simple "knife" excision and may more surely destroy an early carcinoma. In any case a piece of the ulcer wall should be saved for microscopic examination. To avoid secondary hæmorrhage the cautery should not be too hot and the coronary and pyloric arteries should be tied on either side of the ulcer, but even these precautions do not always prevent secondary hæmorrhage when the burnt tissues separate. In 329 cases of cautery excision plus gastro jejunostomy at the Mayo Clinic, the mortality was only 2.12 per cent.⁴ 80 per cent of patients reported satisfactory results from the operation.

(3) (b) **Simple Excision** of a small ulcer is sometimes easy and successful, but recurrences have been unduly common. Upon histological examination what appears to be a simple ulcer occasionally proves to be carcinomatous. J. F. Dobson records ten cases of resection without gastro-enterostomy. Ulceration recurred in four within twelve months, one of these died later from perforation. Secondary gastro-enterostomy was successful in two, and, in another, secondary excision with gastro jejunostomy was successful.⁵ J. Sherren⁶ had to re-operate in 6 out of 9 cases of excision alone. Mr. Collinson⁷ reported 15 cases of recurrence of symptoms following simple excision in 39 cases.

(4) **Excision and gastro enterostomy.** Excision of a large, adherent and penetrating gastric ulcer may be a very formidable operation and the patient may not be able to stand this and gastro jejunostomy at the same time. Moreover, excision of a part of the lesser curvature often interferes with the shape and natural peristalsis of the stomach, so that emptying is delayed and relief incomplete. In such cases it is often wise to perform gastro-jejunostomy first and to excise the ulcer later if necessary, either by knife or cautery.

(5) **Sleeve Resection** has established a definite place in the treatment of selected cases of chronic gastric ulcer. It is particularly suitable for large, indurated,⁸ multiple, often penetrating ulcers, especially of the

¹ *Collected Papers of the Mayo Clinic*, 1921, xiii, 75.

² *Loc. supra cit.*

³ D. C. Balfour, *Ann. of Surg.*, 1919, lxx, 522.

⁴ D. C. Balfour, *Ann. of Surg.*, 1923, lxxviii, 206.

⁵ *Brit. Med. Journ.*, 1912, ii, 884.

⁶ *Index of Prognosis*, 1922, p. 515.

⁷ *Jour. Am. Med. Assoc.*, 1914, lxiii, 1184.

⁸ *Collected Papers of the Mayo Clinic*, 1922, xiv, 72.

central part of the stomach, for some high ulcers, and for hour-glass stomach. E. S. Judd and J. H. Lyons strongly recommend it from a study of 90 sleeve resections—56 of which were for benign gastric ulcer—at the Mayo Clinic between 1908 and 1922. It is interesting that no subsequent death from carcinoma followed this operation, but this is probably due to its frequent adoption for the very chronic type of ulcer which causes hour-glass contraction and is very rarely followed by cancer.

(6) **Partial gastrectomy** for chronic gastric ulcer, as advocated by Sir Berkeley Moynihan, although it has been followed by a low mortality and good results in his skilful hands, is too difficult, drastic and dangerous for frequent adoption. Its mortality in most hands is much higher (7 per cent.) than that of the other available operations, especially for an ulcer high up on the lesser curvature invading the pancreas or liver. It then becomes a very formidable operation; much healthy stomach distal to the ulcer has to be sacrificed and the proximal line of section cannot be far removed from the margin of the ulcer. Moreover, it is not certain that the ultimate results of this extensive operation are good enough to justify its added risk. Some recurrences are known to have followed it, and these are very difficult to treat after the greater part of the stomach has been sacrificed.

For these reasons most surgeons prefer simpler and safer methods such as some form of excision combined with gastro-jejunostomy, reserving partial gastrectomy for cases of suspected malignancy and especially for extensive ulceration in the pyloric segment where resection is comparatively safe and very successful. The writer¹ has used partial gastrectomy for two cases where duodenal ileus was associated with gastric or duodenal ulcer. Sometimes end-to-end union can be safely made after the resection. (Schoemaker), but as a rule wide resection is advisable on account of the fear of existing malignant changes in the ulcer, and then it is easier and safer to make the anastomosis between the upper cut end of the stomach and the side of the jejunum, either in front of or behind the colon: the former is the better plan if malignancy is suspected.

(7) **Jejunostomy.** Jejunostomy has a distinct place in the treatment of very grave cases of gastric ulcer where other operations are too serious, and particularly in those cases where there is extensive ulceration (especially affecting the upper parts of the stomach) with much adhesion or invasion of the neighbouring viscera. Under these circumstances jejunostomy has often proved a life-saving measure, allowing the patient to be fed and giving complete rest to the stomach with great relief of pain. In some cases it is an advantage to perform gastro-jejunostomy at the same time. If necessary, a more radical operation can be carried out when the patient's health has improved.

OPERATIONS FOR GASTRIC ULCER

Cautery Excision

In 1914, D. C. Balfour² introduced this method of eradicating small accessible peptic ulcers without making the unnecessarily large openings which followed excision with the knife or scissors, openings which were difficult to close satisfactorily without deformity or disturbance of func-

¹ *Guy's Hosp. Reps.*, 1926, lxxvi, 158.

² *Surg., Gynec. and Obst.*, 1914, xix, 528.

tion Since then he has employed this excellent method for 725 cases of peptic ulcer and has given us the valuable results of his experience¹ He has successfully applied the method to (1) small gastric ulcers in any situation (2) ulcers of any size in a situation of difficult accessibility, and (3) bleeding gastric or duodenal ulcers He states that

'Ninety per cent of all gastric ulcers involve the lesser curvature and since a large percentage are small the cautery has a wide applicability

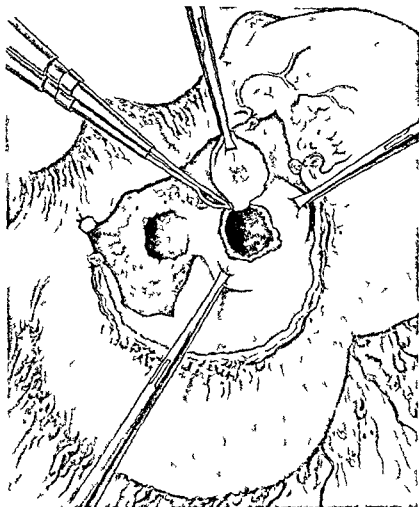


FIG 71 Cautery excision of a posterior mid gastric ulcer invading the pancreas a slice of which has been removed with the ulcer (After D C Balfour and W J Mayo)

The method originally proposed for cautery excision of these small ulcers has been followed that is reflection of the gastro hepatic omentum exposing the peritoneal aspect of the ulcer and accurate location of the crater of the ulcer by palpation the perforation of the centre of the crater by a Paquelin or electric cautery continuing the burning until the crater is completely destroyed closing the opening by chromic catgut sutures and following this procedure with a gastro enterostomy The opening to

¹ *Collected Papers of the Mayo Clinic 1903* xv 98

be closed is, therefore, not larger than the crater itself ; it is closed with ease, and in the entire series of cases there has been no evidence of leakage. The success of the operation is, of course, dependent on the accurate localisation of the crater of the ulcer, and it should be emphasised that the crater of the so-called lesser curvature ulcer is seldom on the lesser curvature ; it is usually on the posterior wall.

“Ulcers with medium-sized craters, that is, between 1 and 2 cm. in

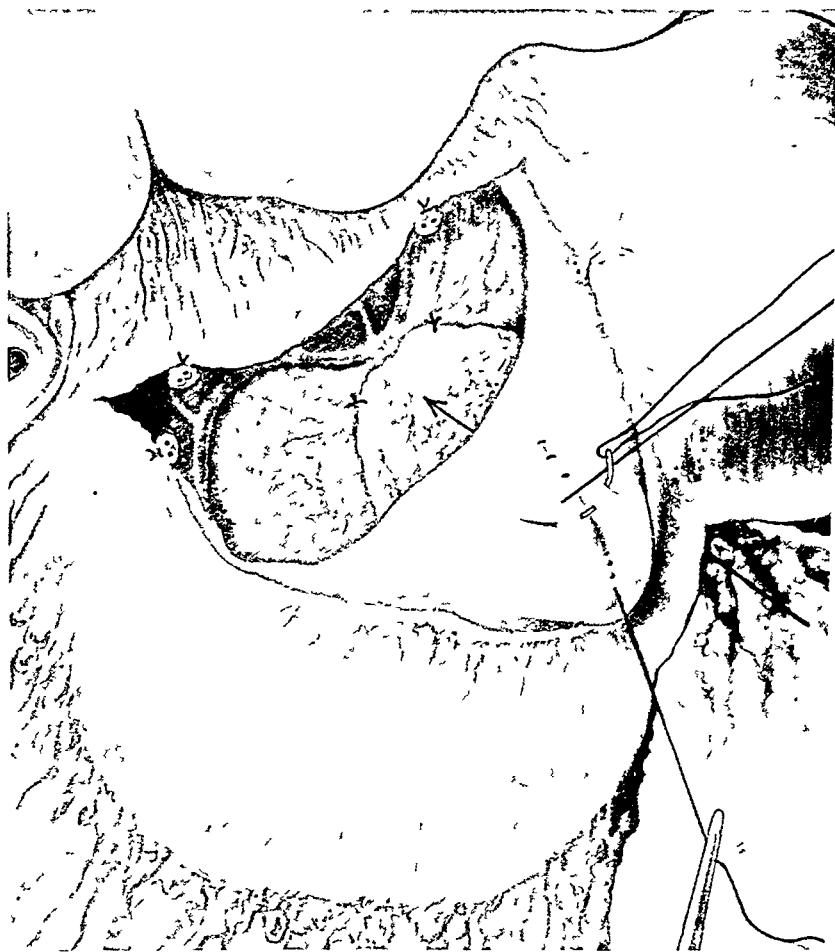


FIG 72 Cautery excision of posterior midgastric ulcer. The gastric wound is closed and a flap of omentum is passed behind the stomach and sutured there. The opening in the lesser omentum is then closed. (After W. J. Mayo)

diameter, may be malignant without visible evidence. Because of this possibility, the crater should be exposed to view by opening the stomach, and an excision made by the cautery knife, as suggested by Sistrunk. The portion of the stomach containing the ulcer is first mobilised, the gastro-hepatic omentum is dissected free, the site of the ulcer encircled and marked by traction forceps, and the crater accurately palpated. At the edge of the crater an incision is made. The crater of the ulcer in its situation on the posterior wall of the stomach is then visualised, excised¹ with a cautery knife, the opening closed in an anteroposterior direction,

¹ It is then examined microscopically for evidence of carcinoma.

and the suture line covered by the peritoneal flap. The operation is completed by a gastro-enterostomy. When ulcers of this size between 1 and 2 cm. are near the pyloric end of the stomach and can easily be mobilised partial gastrectomy is the operation of choice but if they are distant from the pylorus our experience thus far has been that local excision by the cautery and a gastro-enterostomy give such excellent results with such a small operative mortality that one hesitates to employ

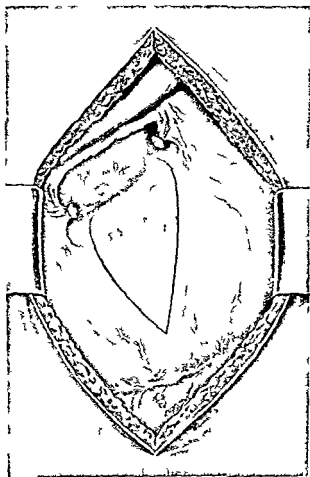


FIG. 73. Excision of a gastric ulcer. The gastric and pyloric vessels have been tied and the lesser omentum divided and detached from the lesser curvature.

an operation of distinctly greater risk. Cautery excision combined with gastro-enterostomy has been performed in the Clinic in 329 cases of gastric ulcer with an operative mortality of 2.12 per cent, a lower mortality rate than has been associated with any other type of operation performed for gastric ulcer in the Clinic. In one series of 148 consecutive cases there was no operative mortality. Eighty per cent. of the patients report satisfactory results from the operation. Fourteen per cent. are only slightly improved, 4 per cent. failed to derive any relief and 1.1 per cent. are known to have developed ulcers subsequently.

"Ulcers over 2 cm. in diameter, as shown by MacCarty, should be regarded as malignant or potentially malignant. Partial gastrectomy is unquestionably justified in these cases, gastro-intestinal continuity being re-established by whatever method best meets the individual case. These large ulcers may, however, be in such a difficult situation that resection is not warranted. For example, large ulcers high on the lesser curvature, while not suitable for resection, may be thoroughly cauterised with little risk. We have dealt with a number of such cases in this manner with surprisingly good results, even when a gastro-enterostomy has not been performed at the same time. In some, excision of the ulcer with the cautery (which may have been only partial) has been combined with jejunostomy, as suggested by Moynihan, and catheter feeding continued until healing has taken place. I believe there is a larger field for this operation than we have realised, and that Moynihan has drawn our attention to a very useful method of dealing with these awkwardly-situated ulcers.

"In the series of 725 cases of peptic ulcer in which cautery excision was performed there have been 1.1 per cent. of recurrences of ulcers, including gastro-jejunal. There is apparently no greater tendency for an ulcer to recur at the point of excision (providing, of course, that the ulcer has been satisfactorily excised) than at any other part of the stomach. The fact that in 725 cases we have seen no evidence of a tendency for an ulcer to develop at the point of excision would disprove any theory, or fear, that the cautery, of itself, may give rise to ulcer. Mann has demonstrated that, after extensive excision of the gastric wall by the cautery, healing was so perfect that it was impossible to detect where the excision had been made, and we have observed in patients operated on for other conditions at various intervals after such excision, that the same perfect healing has taken place. This small percentage of recurrences of ulcer following local excision and gastro-enterostomy is not of itself an argument for routine gastrectomy in gastric ulcer. . . . The cautery is a useful adjunct in the management of ulcers on the posterior wall of the stomach, particularly when they are adherent to the pancreas. In these cases it is necessary, in order to secure good end-results, to separate the stomach from the pancreas; the edges of the opening are then excised with the cautery, and the area on the pancreas thoroughly seared."

Simple Excision

This operation may be very difficult, especially when the ulcer is high and adherent on the lesser curvature or posterior wall of the stomach. Large ulcers invading the liver or pancreas are usually irremovable without undue risk to the patient's life, and for these it is better not to attempt anything beyond gastro-jejunostomy or jejunostomy and prolonged medical after-treatment. The abdomen is opened through a left paramedian incision beginning in the left costo-xiphoid angle and extending below the navel.

As usual, the abdomen is thoroughly but quickly explored, the appendix removed if time permits, and the stomach and duodenum carefully examined before any attempt is made to remove an ulcer. The round ligament is clamped, divided and used as a tractor¹ to draw the left

¹ E. S. Judd and F. W. Rankin, *Collected Papers of the Mayo Clinic*, 1923, xv, 107.

lobe of the liver upwards out of the way. Adhesions are separated and any bleeding vessels are tied.

(1) *If the ulcer is limited to the anterior wall of the stomach it is picked up with the fingers and thumb of the left hand while the right hand applies a strong clamp well behind it. An assistant holds the clamp and draws it downwards and to the right. Packs are carefully placed to protect the peritoneum and the edges of the wound and an incision is made*

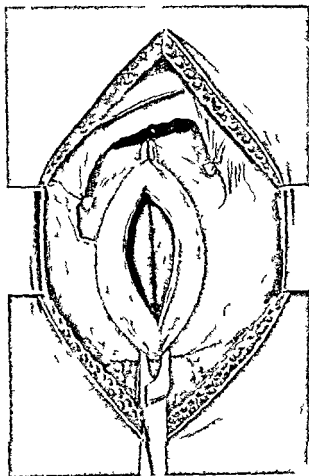


FIG. 74. Excision of a gastric ulcer. Here a single clamp is placed. The ulcer has been excised and the wound is ready for suture.

around the ulcer and about half an inch away from it. When the clamp has been properly placed the lips of the gastric wound project about an inch beyond it so that the wound may be easily closed without shifting the clamp. Two continuous sutures of fine catgut are used: one pierces all the coats and is drawn and held taut throughout to prevent bleeding; the other is inserted after the clamp has been removed and its insertion is facilitated by traction upon the lower end of the deep suture which is temporarily left long for this purpose (see Figs. 74 and 78).

(2) *When the ulcer is upon the lesser curvature*, the lesser omentum is divided at a bloodless part well above the ulcer and any enlarged glands that may be present. The gastric and pyloric vessels are then tied and divided above and below the ulcer. The fingers of the left hand are passed through the opening in the lesser omentum and the ulcer is thus grasped and brought down for the application of traction forceps or clamps. Judd and Rankin¹ hold the stomach up with several traction forceps, applied near the ulcer. The latter is accurately located and outlined by an

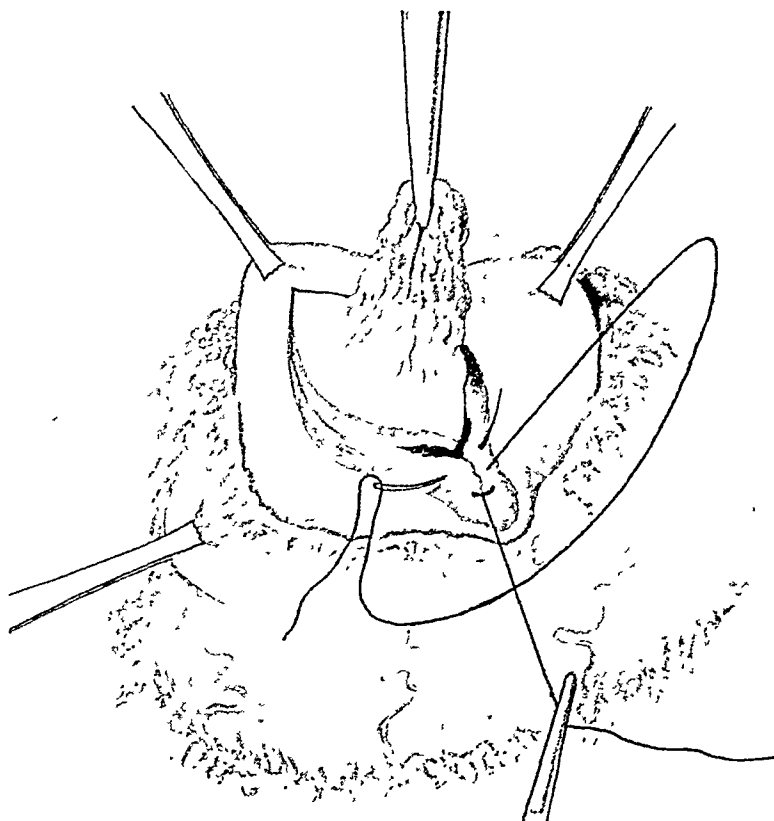


FIG. 75. Excision of a posterior gastric ulcer without the aid of clamps, the empty stomach being held up by forceps; the gastric wound is made and closed little by little, a large gaping wound being thus avoided. (After E. S. Judd and F. W. Rankin.)

incision through the sero-muscular coat. A small opening is made in the mucosa just below and in front of the ulcer. The deep suture, picking up the mucosa, is started at once and continued up as the mucosa is gradually divided on either side of the ulcer, so that the opening is closed immediately, without gaping or leakage. In some cases a single strong curved clamp is very useful, the stomach being rotated so that the tips of the blades can reach well beyond the posterior inferior extremity of the saddle-shaped ulcer. A pack of gauze is introduced behind the stomach, and the ulcer is excised as already described (see Figs. 73 to 75).

¹ *Loc. supra cit.*

When the ulcer is large and not easily accessible two clamps are necessary and are applied from above down on either side of the ulcer. It is an advantage to have the left one bayonet shaped to dodge the left costal margin. The ulcer is excised without approaching too near the greater curvature. The clamps are approximated and the large wound thus left is closed with two layers of sutures. This may be very difficult as regards the posterior part of the wound. Whenever possible a con-

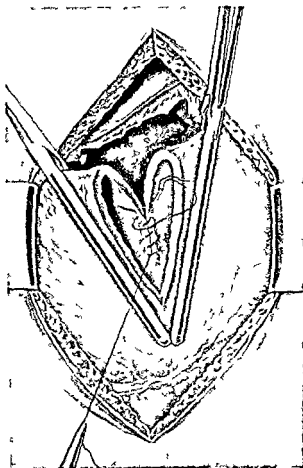


FIG 76 Excision of gastric ulcer. Two clamps used. Suture of the wound starting below and behind.

tinuous Connell suture of catgut is introduced and reinforced by a continuous Lembert or Cushing suture.

The sewing is commenced at the posterior inferior angle of the wound. When the wound extends far down upon the posterior surface of the stomach it may be almost impossible to insert the serous suture in the usual way. The posterior inferior angle of the wound is seized with tissue forceps and drawn downwards and forwards while an ordinary continuous piercing suture is rapidly inserted from below upwards as far as the lesser curvature. The needle is then passed under the last turn and laid aside.

while a Connell suture is introduced from below up from within the stomach. This "loop on the mucosa" suture buries itself so that none of it is seen on the serous surface and there is no risk of leakage along it. When the lesser curvature has been reached the needle, after passing from within out on to the serous surface on the left of the wound, is laid aside while the deep suture is completed after Connell's method. The second suture is then completed as a serous suture (*see* Figs. 76 to 78).

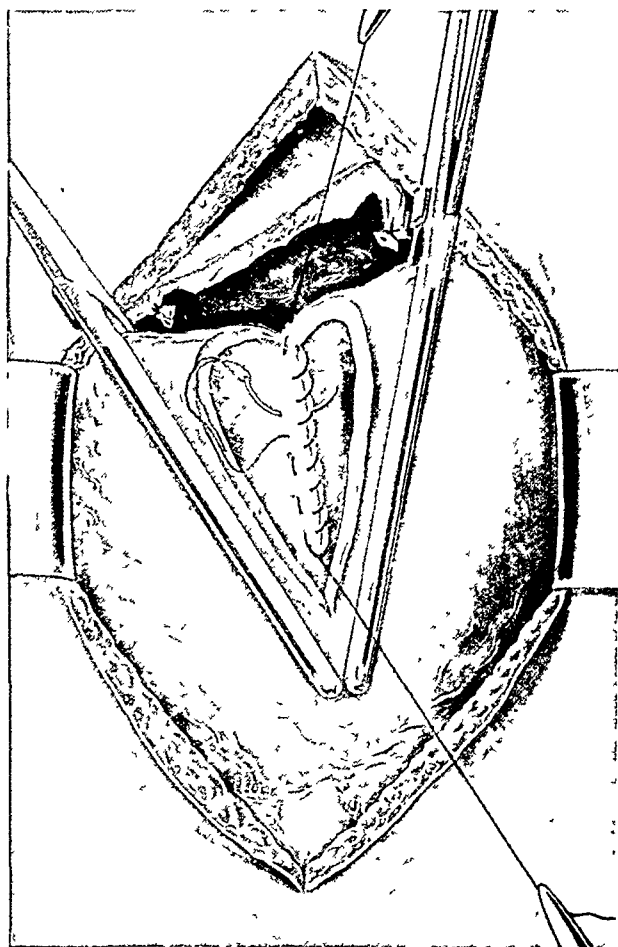


FIG. 77. Excision of gastric ulcer. The posterior continuous (Connell) suture is being inserted from within the stomach.

As a rule a posterior ulcer is near the lesser curvature and is best excised after dividing the gastro-hepatic omentum and rotating the stomach.

Sometimes an ulcer low on the posterior wall of the stomach is best approached from below through the gastro-colic omentum. Occasionally the opening left after removing the ulcer can be extended downwards and used for posterior gastro-jejunostomy.

(3) *Transgastric Excision*.—Sometimes adherent ulcers on the posterior wall of the stomach cannot be reached satisfactorily either through the

lesser omentum or gastro-colic ligament or both. Then *transgastric excision*¹ is indicated. W J Mayo² gives a good account of this operation.

The gastro hepatic and gastro colic omenta are opened above and below the ulcer. Gauze protection is introduced, adhesions are carefully separated and if possible the ulcer surface is cut free from the posterior attachments without opening the stomach. A piece of gauze is packed

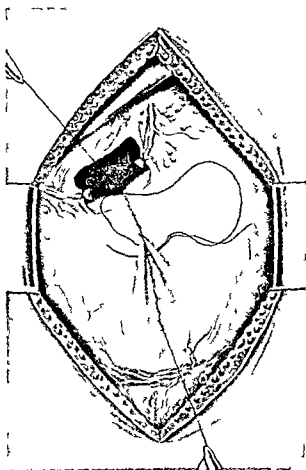


FIG 78. Excision of gastric ulcer. The first and second sutures are nearly completed.

into the denuded area behind, and in all but one of our cases this temporary pack was adequate to stop hæmorrhage without the ligation of vessels. The anterior wall of the stomach is opened and with the fingers behind, the entire ulcerated surface is pressed through the anterior incision and the ulcer excised. The gap is sutured with through and through sutures of chromic catgut from the mucous side transversely and this suture line is further protected by several mattress sutures applied from the mucous side. The anterior wall of the stomach is then closed. Several rubber

¹ Pitcher *Long Island Med Journ*, May 1907

² *Ann of Surg* 1910 lii "97

tissue drains are carried down behind the stomach and brought out at the upper end of the abdominal wound as a safeguard" (see Fig. 79).

Sleeve Resection.

The pyloric, gastric, and the right and left epiploic vessels are divided between ligatures at selected points on either side of the ulcer. The lesser omentum and the gastro-colic ligament are divided (above and below their contained lymph glands), thus opening the lesser sac of the peritoneum

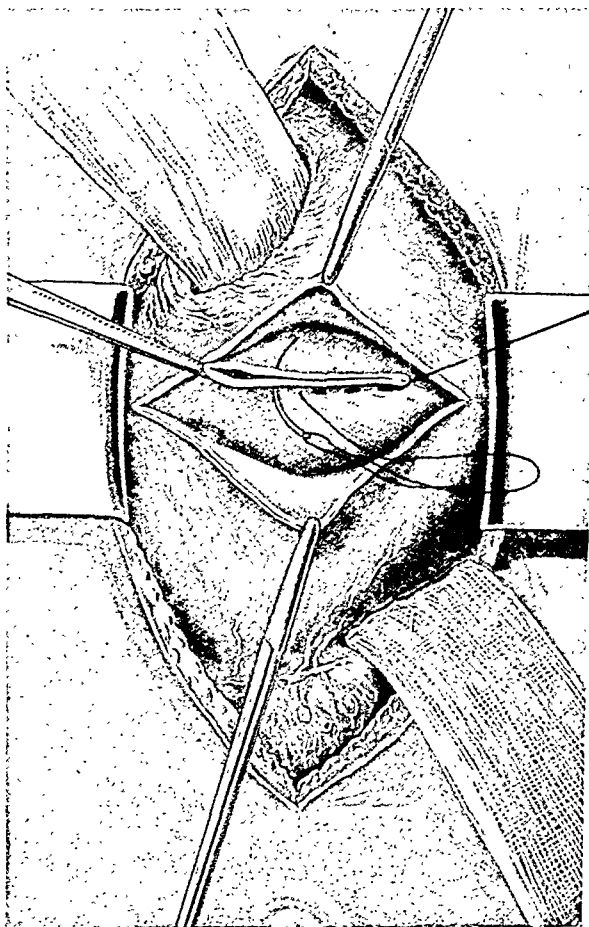


FIG. 79. Transgastric excision of a posterior gastric ulcer (after Mayo). A Connell continuous suture is being inserted after the ulcer has been excised.

freely, and the hand is introduced to examine the posterior wall of the stomach for adhesions. If these are slight they are separated at this stage and a large, broad pad of warm moist gauze is passed behind the stomach to hold it forwards. Two pairs of clamps are then carefully applied on either side of the proposed line of section and the stomach is divided close to the outer side of each central clamp, leaving enough stomach projecting beyond the pyloric and cardiac clamps to allow easy insertion of the first or posterior half of the sero-muscular suture after these clamps have been approximated, and a deep continuous suture of

No 1 catgut is begun at the upper border of the stomach and is continued down to the greater curvature. It pierces all the coats, is carried up in front of the stomach and finishes at the point of origin on the lesser curvature. The sero muscular suture is then completed in front.

When the ulcer is very adherent behind it is an advantage to divide the stomach first on the pyloric side of the ulcer then to draw the middle part of the stomach forwards and to the left so that the ulcer can be gradually separated from the pancreas. The aid of direct vision is invaluable. It is generally necessary and wise to shave off some of the pancreas with the ulcer, remembering that otherwise there is considerable risk of opening the latter and causing a troublesome and dangerous leak of the gastric contents.

If the cardiac or left section has to be made very high up it is a great advantage to insert the sero muscular suture before this section is made, for the part to be removed makes a valuable tractor as in the operation of partial gastrectomy. When the anastomosis has been completed the openings in the omentum above and below the stomach are closed.

PARTIAL GASTRECTOMY

Partial gastrectomy for simple ulcer may be carried out in one of the ways described and figured under cancer of the stomach. If the diagnosis is certain one of the less extensive resections is carried out but in many cases the exact nature of the ulcer is so doubtful that it is best to err on the safe side by adopting wide resection in these cases.

DUODENAL ULCER

When duodenal ulceration recurs in spite of patient and persevering medical treatment an operation is indicated in order to save the patient from the grave risks of severe hæmorrhage and perforation and also to prevent him from drifting into chronic invalidism. Unless there are grave constitutional reasons against any operation the risks of operating for duodenal ulcer are less than those of conservative treatment and this is especially true of hospital patients who are unable for economic reasons to carry out prolonged and adequate medical treatment. It is fortunate that there is little risk of malignant disease developing in a duodenal ulcer.

Gastro jejunostomy has been very successful in the treatment of this disease, carrying but a small risk of death (say 1.5 per cent) and offering a very good chance of cure (over 90 per cent).¹ In a few cases however vicious vomiting, jejunal ulceration or recurrent hæmorrhage may follow the operation. For these reasons some surgeons have adopted other measures in selected cases. For duodenal stenosis in the absence of troublesome adhesions or active ulceration especially on the posterior surface of the duodenum Finney's operation has been very successful. Ulcers on the anterior wall have also been successfully excised during the performance of this operation. In similar cases gastro duodenostomy has been performed and these operations have the merit of almost certainly avoiding vicious circle, jejunal or marginal ulceration and also recurrent hæmorrhage if the ulcer can be excised at the same time. They, however, have the disadvantage that they do not as a rule drain the stomach so

¹ *Collected Papers of the Mayo Clinic* 1924 xvi 60 and *W. J. Mayo Surg., Gyn. and Obstet.* 1924 xxxix, 241.



FIG. 80. Excision of an anterior duodenal ulcer. A curved or straight incision parallel to the axis of the bowel and dividing the pyloric sphincter is a good one.

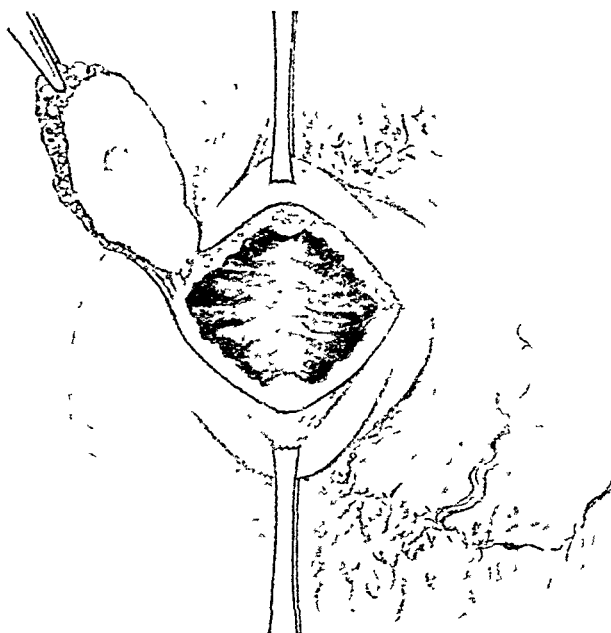


FIG. 81. Excision of an anterior duodenal ulcer.

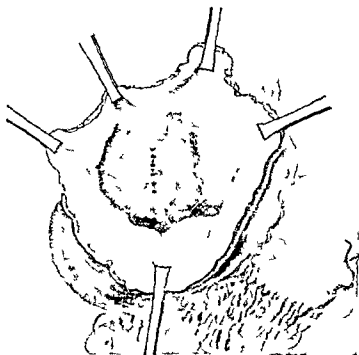


FIG. 82. Excision of anterior and posterior duodenal ulcers. (After F. S. Judd and F. W. Rankin.)

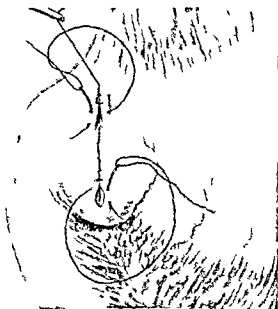


FIG. 83. Excision of duodenal ulcer. The wound is closed in such a way that the channel is enlarged.

thoroughly nor do they allow the alkaline contents of the duodenum to enter the stomach so freely to check and neutralise the over-acid gastric secretion. Moreover, they are not so easy nor quite so safe as gastro-jejunostomy. For certain cases the ulcer-bearing segment of the duodenum has been excised with end-to-end or end-to-side union. The above objections apply with added force to this operation. C. A. Pannett¹ has recorded an interesting study of this operation with 16 recoveries in 18 cases. The present writer has used this method successfully in three selected cases. When hæmorrhage has been a prominent feature before the operation, it is particularly important to apply some local treatment to the ulcer at the time of performing the gastro-enterostomy. The ulcer can be excised either with knife or cautery or it can be under-run and invaginated by catgut sutures. In some cases this local treatment has to be applied at a second operation when hæmorrhage has occurred after gastro-jejunostomy. With the idea of diminishing the amount of acid secreted, partial gastrectomy has been advocated as a treatment of duodenal ulcer, but this seems to me too severe an operation, especially as the results of simple gastro-jejunostomy with local treatment of the ulcer in selected cases has been so very successful, and as there is no fear of malignant disease supervening upon a duodenal ulcer. In 6,665 operations for duodenal ulcer at the Mayo Clinic,² gastro-enterostomy was performed in 86·35 per cent., pyloro-plasty or gastro-duodenostomy in 4·07 per cent., excision alone in 3·9 per cent., and partial gastrectomy in only 0·45 per cent.

HÆMORRHAGE FROM GASTRIC AND DUODENAL ULCERS

Severe hæmorrhage takes place in only about a third of the cases³ of ulceration of the stomach and duodenum, and even then it is usually a late symptom, although it is sometimes the first sign of an acute ulcer. It is needless to say that there are other causes of hæmatemesis and melæna, such as congestion of the mucous membrane due to cirrhosis of the liver or heart disease, cholecystitis, chronic appendicitis, splenic anæmia, carcinoma of the stomach, and various diseases of the blood.

It is not very easy to estimate the percentage of deaths from hæmorrhage in cases of gastric ulcer under medical treatment, for the fatalities vary inversely with the duration and thoroughness of the treatment. Dr. Bulstrode⁴ collected the records of 500 cases of gastric ulcer admitted into the London Hospital between 1897 and 1903. He found that 2·5 per cent. of these patients died from hæmorrhage.

Dr. Hawkins and Mr. Nitch⁵ found that less than 1 per cent. of 419 consecutive cases of gastric ulcer collected from the records of St. Thomas's Hospital died of bleeding.

These figures show how efficient medical treatment for bleeding may be if carefully carried out, but unfortunately it is not practicable under existing circumstances to treat all the poor subjects of gastric ulcer by rest and dieting for the long time that is necessary for cure. Too often

¹ *Brit. Journ. of Surgery*, 1924, xii, p. 273.

² D. C. Balfour, *Collected Papers of the Mayo Clinic*, 1924, xvi, 75.

³ H. J. Paterson, *Lancet*, 1924, i, 543.

⁴ *Clin. Soc. Trans.*, 1903, p. 86.

⁵ *Royal Med.-Chir., Soc.* xc, 269.

they have to return to work before the ulcer is healed, therefore, it is not surprising that relapses are so frequent

It should be remembered also that a timely operation for the relief of recurrent hæmorrhage may not only arrest the bleeding, but may lead to healing of the ulcer and prevention of perforation and other complications and sequelæ which, although they may not always be immediately fatal, yet shorten or spoil many lives

That hæmorrhage is an important cause of death is shown by the following facts Dr Wall¹ found that of the cases of gastric ulcer with bleeding as a symptom 6 per cent of the women and 12·5 per cent of the men over thirty years of age died from hæmorrhage alone. MacNevin and Herrick (quoted by Hale White²) state that of 55 cases of undoubted gastric ulcer, shown at a post mortem examination, which died from either perforation or hæmorrhage, 25 died from hæmorrhage Dr J J Conybeare³ investigated the records of over 600 cases admitted into Guy's Hospital between 1911 and 1920, for hæmorrhage from an acute or chronic gastric or duodenal ulcer and found that the mortality under medical treatment was 2·5 per cent H J Paterson,⁴ however, studied the records of some of the large London hospitals and calculated that 11 per cent of those cases admitted for severe hæmorrhage and treated medically died from bleeding

The ulcers which give rise to serious hæmorrhage are usually situated on the posterior wall of the stomach and near the lesser curvature The character of the ulcers is very variable They may be small and quite superficial, or deep and adherent to structures outside the stomach, leading to ulceration of large vessels such as the coronary pyloric, gastro-epiploic, hepatic, splenic, gastro duodenal or even the aorta In some cases more than one ulcer or erosion are present, in others the ulceration may be in the duodenum, or no ulcer may be discovered or even exist

Sir William Hale White⁵ collected 29 cases of "gastrostaxis" or the oozing of blood from the mucous membrane of the stomach Only two of these patients were males and most of them were women well under forty years of age Although this condition is rarely fatal under medical treatment, 8 deaths occurred in 24 cases treated by operation a mortality of 27·5 per cent Careful examination and "interval" operation generally reveal chronic appendicitis, cholecystitis or some other source of sepsis in the abdomen

Treatment Bleeding may take place from (a) acute or (b) chronic ulcer

(a) Bleeding from an Acute Ulcer may be the first abrupt sign of the disease and may be severe It is rarely fatal, but usually ceases spontaneously, may never recur, and the patient soon recovers from the resulting anæmia It is clear that no one should advise an operation in such cases, especially as no visible lesion may be found even when the stomach is opened and carefully examined In other cases, erosions, weeping areas or minute but deep ulcers have been found Absolute rest, morphia, with only a little water, ice and adrenalin chloride by the mouth

¹ *Clin Soc Trans*, 1903, p 90

² *Lancet*, 1906, ii, 1189

³ *Lancet*, 1924, i, 545

⁴ *Ibid*, p 543

⁵ *Loc supra cit*

and rectal salines are generally sufficient. Blood transfusion is sometimes necessary and increases the coagulability of the blood and thus tends to arrest hæmorrhage as well as to make up the loss already sustained. Hæmoplastin or horse serum may be injected subcutaneously, or 5 c.c. of a 10 per cent. solution of calcium chloride intravenously to hasten clotting. The chances of arrest of hæmorrhage and recovery are much greater without an operation, which, experience has clearly shown, greatly adds to the patient's peril. Operation during the bleeding is too dangerous, and after it has ceased it is unnecessary and meddlesome, for the bleeding may never recur as the ulcer usually heals under careful medical treatment; but if radiography shows that the crater of an ulcer does not disappear under three months' medical treatment it is wise to operate, to prevent recurrence of and perhaps death from bleeding.

(b) **Bleeding from a Chronic Ulcer** is quite different, for chronic ulcers heal with difficulty even under a careful and prolonged medical treatment, so that an operation in a quiescent period is strongly indicated both to prevent the recurrence of bleeding and to cure the ulceration.

In the majority of cases of gastric ulcer bleeding is slight or even microscopic, causing an increasing anæmia but not a grave emergency. Failing medical treatment an operation is indicated. Usually moderate or severe hæmorrhage is intermittent, and it is very rarely wise to operate during an attack, for it is safer to operate early in the interval before a grave or fatal recurrence can take place. A radiographic examination must be made without delay to prove the presence of an ulcer and to locate it. When the bleeding has been very severe, and especially when the ulcer is in the duodenum, at the lesser curvature of the stomach or at the pylorus where large vessels are likely to be eroded, it is wise to operate after one attack. Sometimes a large vessel such as the gastro-duodenal, splenic, aorta or vena cava is opened, the patient is so very ill or death takes place in such a short time that an operation is out of the question. Occasionally when the bleeding is very severe, especially from a duodenal ulcer, and the patient very ill with all the signs of severe hæmorrhage, which do not abate under absolute rest and medical treatment, it is very difficult to decide what to do; but Paterson's¹ opinion is probably right "that it would be well within the mark to state that, of the patients who bleed severely and repeatedly and are treated medically, not more than 1 in 9 would die, while of those treated by immediate operation, 1 out of 3 would probably die." H. Finsterer² advocates operating early in the attack of severe hæmorrhage, often performing partial gastrectomy, and claiming a low mortality (5.5 per cent.) when the operation was undertaken within forty-eight hours of the onset of bleeding, but surely gastrectomy is too severe and drastic under these circumstances. The writer has been glad to limit his few operations undertaken during severe hæmorrhage to infolding the ulcer and tying the entering vessels, and success has been attained in some apparently hopeless cases, the whole operation being performed speedily and lasting not more than twenty minutes. Blood transfusion can be performed at the same time if a suitable donor can be obtained at short notice. In these cases gastro-jejunostomy if necessary can be done later with less risk.

¹ *Loc. supra cit.*

² *Med. Klin.*, 1922, xviii, 861-863.

Operation. Nearly always it is safer to wait for an intermission and until the patient has rallied. The incision in the epigastrium must be free and paramedian.

The stomach and duodenum are carefully examined by inspection and palpation. The stomach is sometimes so distended with gas and blood that a proper examination is impossible until a stomach tube has been passed by an assistant. Special attention is paid to the lesser curvature and pyloric regions. A greyish white depression, induration or adhesion often indicates a chronic ulcer. Occasionally several ulcers are found, sometimes one on the lesser curvature of the stomach and another in the duodenum. If bleeding is in progress the ulcer is at once invaginated with two continuous catgut sutures. The first pierces all the coats of the stomach after Connell's method about a quarter of an inch away from the edges of the ulcer. When this is drawn tight it should stop all bleeding from the ulcer, a second or sero muscular continuous suture is added. If it is difficult to reach and secure a saddle-shaped ulcer high on the lesser curvature, some of the fibres of the left rectus are divided and the left costal margin is retracted while the lower part of the stomach is grasped and drawn downwards and to the right by an assistant. The coronary and pyloric arteries are tied and the lesser omentum incised so that the posterior part of the ulcer may be brought forward into view and treated as already indicated. When an ulcer on the lesser curvature is widely adherent to or invades the liver, it should not be detached but if possible the vessels approaching it should be tied. Similarly an ulcer of the stomach or duodenum may invade the pancreas, so that it is impossible to under run its vessels in the usual way. In such cases the approaching arteries should be tied. the gastroduodenal or pyloric can be tied just above the duodenum and the right gastroepiploic just below the pylorus.

D. C. Balfour¹ strongly advocates the radical and direct treatment of all ulcers which are known to have bled severely, for recurrence of bleeding after gastro jejunostomy is known to take place in 13 per cent. of these, whereas it occurs in less than 1 per cent. after the ulcer has been destroyed or removed. It is also important to remove gastric ulcers owing to the danger of malignancy.

In most cases gastro jejunostomy is performed, for it is very valuable in arresting hæmorrhage, in preventing its recurrence, and in promoting the healing of the ulcer. When no ulcer can be discovered by careful and speedy inspection and palpation no operation must be performed on the stomach, but some indirect cause of bleeding sought, such as splenic anæmia, chronic appendicitis, cholecystitis or cirrhosis of the liver. As a rule, the radiographic examination will have shown whether an ulcer is present or not.

Many other methods of dealing directly with the bleeding area have been tried but none of them is so speedy, simple and effectual as infolding and ligation of vessels in the manner described above. Excision, ligation and cauterisation of the ulcer may be mentioned, but even if the bleeding spot is found these methods are difficult and tedious, and add greatly to the patient's peril by increasing shock in a subject already exhausted by hæmorrhage. Exploring the interior of the stomach when no ulcer is feelable is to be specially condemned, for no ulcer or definite bleeding spot may be found, and the operation is unnecessarily prolonged.

¹ *Collected Papers of the Mayo Clinic*, 1922, xiv, 53.

CHAPTER VII

GASTRO-JEJUNOSTOMY¹

IN this operation a direct communication is made between the stomach and the jejunum. The anastomosis may be either anterior or posterior as regards the stomach and transverse colon. Although the operation is a very valuable one in suitable cases, it should only be performed after careful consideration. The immediate risk is now so slight that it may be performed without adequate reason; therefore, it is most important to consider the indications for and against the operation. It should never be performed except for demonstrable organic disease or obstruction of the stomach or duodenum, for, apart from these, the operation is not only useless but may be very harmful in its ultimate results.

It is necessary to refuse the operation in late cases of growth, and particularly in all cases of gastric neurosis, gastropotosis or chronic dilatation. To perform gastro-jejunosomy for the crisis of locomotor ataxy or the vomiting of early phthisis can only be due to gross carelessness in diagnosis. These and similar mistakes show that this valuable operation has been abused. When exploration of the abdomen fails to reveal an adequate cause for the operation it should not be performed, but some other cause of the symptoms must be sought, especially disease of the appendix or gall-bladder. A general careful exploration must be made.

On the other hand, the operation is too long deferred in many suitable cases. Both the immediate and the ultimate results are much better if the operation is performed at the right time, and years of misery may be prevented by more careful examination of the stomach, especially by radiography. In other cases a timely exploration will at once prove that a gastro-jejunosomy is strongly indicated.

Indications. (A) **Selected cases of gastric and duodenal ulceration.**

(i) In most cases of pyloric or duodenal stenosis due to contraction of a healed ulcer, but in some of these cases without much dilatation, especially in women, gastro-duodenostomy is to be preferred. Delay in emptying and dilatation of the stomach are shown by the vomiting of large quantities of characteristic material, by examination of the gastric contents withdrawn by means of the stomach tube at intervals after a test meal and, especially, by X-ray examination. The operation should be undertaken long before there is great dilatation of the stomach, much wasting or such late symptoms as gastric tetany. In slight cases as shown by Maylard the symptoms of obstruction are intermittent, an attack being brought on by overwork, mental fatigue or indiscretion in diet, and abating as soon as the patient rests under medical treatment. Gastric tetany is nearly always due to pyloric stenosis and then calls for prompt

¹ To be accurate, the term gastro-jejunosomy should be used for union of jejunum to stomach, gastro-duodenostomy for union of duodenum and stomach. The term gastro-enterostomy, which has been carelessly used for either of the above operations, should be dropped.

gastro jejunostomy, for delay may be fatal. I remember a patient dying in a spasm during the night before the day fixed for her operation. The prognosis after operation is not nearly so grave as used to be thought, and Moynihan reports fourteen operations for it without a single death. The anæsthetic stops the spasms but a few may occur after the operation.

(u) In all cases of chronic or relapsing ulcer of the duodenum, whose symptoms have not been abolished by complete rest from work for three months with careful dieting and medicinal treatment, or where symptoms recur after such treatment. In certain cases the operation has to be undertaken earlier, for adequate medical treatment may not be practicable on account of poverty or intolerance, or the patient may not do well under it but may waste, bleed or develop signs of dilatation.

(w) For recurrent hæmorrhage from chronic gastric or duodenal ulcers. Gastro-jejunostomy is the speediest, simplest and most efficient way of preventing hæmorrhage in these grave cases. In most cases cautery or knife excision or infolding of the ulcer should also be done to prevent recurrence of bleeding or the onset of carcinoma in a gastric ulcer. It is rarely wise to operate during severe hæmorrhage.

(iv) In a few cases of perforating ulcers in the same area or at the neck of an hour glass stomach suturing narrows the passage to a serious extent, or, from the size of the ulcer healing may be expected to do the same, but Ellsworth Elliot and MacCallum¹ experimenting on cats and dogs respectively, found it difficult to produce permanent narrowing of the duodenum by excising fairly large portions of its wall and suturing the large perforations thus made. Primary gastro jejunostomy can rarely be borne, and even secondary gastro enterostomy becomes necessary in only about a quarter of these cases.

(v) In certain cases of chronic ulceration of other parts of the stomach, when symptoms persist in spite of careful medical treatment and where excision is impracticable without grave risk on account of the extent, position or adhesion of the ulcer which may be invading the pancreas or liver. The excision of such an ulcer may be a very formidable and dangerous operation so that gastro jejunostomy is easier and safer, although it may not seem so good. I have found it very efficient in immediately relieving the severe pain commonly associated with ulcers on the lesser curvature. It also undoubtedly promotes healing. Once I had to open the abdomen a year later for intestinal obstruction and I found only a small scar where there had been a large ulcer on the lesser curvature. In one patient, however, although the pain ceased at once and the patient gained weight and improved almost out of recognition, severe hæmorrhage suddenly came on six months later and recurred. I then removed the ulcer, which is in the Museum at Guy's Hospital and shows a bristle in the perforated gastric artery. The patient made a good recovery and has remained well for years. The gastro jejunostomy opening was a large one and had not narrowed by the time of the second operation. In most cases cautery or knife excision of the ulcer is combined with gastro jejunostomy, for excision avoids the danger of present or future malignant change in the ulcer, and the gastro jejunostomy aids the healing of the large wound in the stomach and may prevent the recurrence of ulceration.

¹ *Ann. of Surg.*, 1912, iv, 546.

(vi) For certain cases of hour-glass contraction of the stomach in which the pyloric pouch is small and the pylorus is not contracted. An anastomosis between the large cardiac pouch and the jejunum is then the best and simplest treatment.

B. Certain cases of irremovable pyloric or duodenal obstruction from (1) adhesions outside, such as may occasionally follow perforation of a gastric or duodenal ulcer or disease of the gall-bladder, or may be due to (2) the pressure of a new growth of the gall-bladder, pancreas or right kidney.

C. Stenosis of the pylorus or pyloric segment of the stomach due to corrosive poisoning. Sometimes a gastrostomy is also required at the same time. In one of my cases the pyloric obstruction was naturally overshadowed by the œsophageal obstruction and was only discovered after the abdomen had been opened. Both operations were rapidly performed and the patient made a good recovery. The gastrostomy was only required for a few weeks. The following case shows the amount of damage that may be done to the stomach by a corrosive, without permanent injury to the œsophagus or perforation of the stomach.¹

A man, *æt.* 41, in a fit of depression swallowed about six ounces of spirits of salts² on April 13, 1910, and suffered severely from shock, and later from dysphagia hæmatemesis and vomiting. On May 13, 1910, he vomited a cast of the pyloric half of his stomach. This consisted of the whole thickness of the mucous membrane with some of the sub-mucous tissue and muscular coat. The vomiting increased and the patient wasted rapidly. The cardiac remainder of the stomach dilated but the pyloric portion was practically obliterated, as shown by Dr. Hurst upon examination with the bismuth and X-ray method. I operated on June 13. The abdomen was opened through the upper part of the left rectus. The cardiac part of the stomach was so distended that it was difficult to get a view of the pyloric part and of the duodenum, and it was found impossible to bring the posterior wall of the stomach down through the rent made in the transverse mesocolon, although the patient had not had any food by the mouth for nine hours. A stomach tube was passed, and two and a half pints of coffee-coloured liquid and debris, but no gas, escaped. It was now quite easy to examine the stomach thoroughly. The pyloric part was hard and narrower than the first part of the duodenum, which was quite normal. It looked like a narrow and thick-walled piece of small intestine; it was fixed to the posterior wall of the abdomen. The narrowing was most marked five inches from the pylorus, immediately to the right of the distended cardiac pouch. From this point a tough thick band extended to the under surface of the right lobe of the liver. The gastro-colic omentum had been drawn up at the same spot and was adherent to the front wall of the stomach and to the lesser omentum. Otherwise the anterior wall of the stomach was free from adhesions. There were many enlarged and very hard glands in the lesser omentum and about the head of the pancreas. Several recent adhesions were present on the under surface of the transverse mesocolon towards the right, and the mesocolon was generally shrunken, so that it was rather difficult to make a free opening within the loop of blood-vessels. Owing to the adhesions between the pyloric part of the stomach and the posterior wall of the lesser sac, it was difficult to bring any of the cardiac pouch down through the mesenteric aperture. With the aid of clamps posterior gastro-jejunostomy was performed after Mayo's method. The mucous membrane of the stomach was inflamed, thin and very friable. The sero-muscular coats of the stomach were also thinner, and far more friable than natural, so that the sero-muscular suture tore out at several places. The patient bore the operation well and made a rapid and complete recovery. His mental depression also soon disappeared. He was quite well in every way for many years, and then hung himself in another fit of depression.

D. Malignant disease of the stomach or duodenum under the following conditions: (i) *Together with partial gastrectomy.* This is always to be

¹ Clarke, Hurst and Rowlands, *Guy's Hospital Reports*, 1910, Ixiv, 295.

² Spirits of salts are about the same strength as acidum hydrochloricum.

preferred to an end to end union because it allows the more free removal of the growth shortens the operation and makes it easier. A very thorough examination of the liver pancreas and peritoneum should precede the resection. When the patient is feeble the gastro jejunostomy should be done first so that the resection may be deferred until another time if the patient is not standing the operation well. (u) *As a preliminary to partial gastrectomy, a fistula should be performed two or three weeks later.* This is more valuable in feeble patients for it enables them to eat freely and improve their nutrition sufficiently to bear the second operation. But this plan has the objection that the patient's condition may be so much improved that he refuses the radical operation.

(w) *Alone.* This is clearly a very inferior operation to those of gastro jejunostomy with either primary or secondary resection. If all the cases of gastro jejunostomy which have been performed for growth had been published it is certain that the results both as regards the immediate mortality and the duration of life would be most disappointing. This is partly because the operation has been far too often performed in very emaciated patients quite unfit to bear the operation and to supply the necessary plastic repair. For the future simple gastro jejunostomy should be reserved for the following cases: (i) When the growth causes obstruction and is irremovable, that is when a growth extends too far along the lesser curvature of the stomach or when it is too fixed to the liver or pancreas to make a partial gastrectomy justifiable or secondary deposits and fixed enlarged glands can be felt. Gastro jejunostomy is worse than useless when the growth does not cause obstruction. (ii) Where the cachexia and emaciation are not too severe. The risks of pulmonary and other complications in these late cases must also be remembered.

These marasmic patients also suffer much more severely from shock than those with non malignant disease even when the operation is very quickly performed.

If the operation be reserved for the above cases it will be called for less frequently than of late years but will be found in these to give great relief and to prolong life for some months. If surgeons continue to perform it as gastrostomy has been too often performed for malignant disease of the oesophagus in cases where the operation comes too late their patients if they survive will do so for a very short time succumbing to the effects of a marasmus so established as to be unalterable.

In recent years improvements in the technique of the operation have greatly reduced its mortality even in malignant disease.

It is to be hoped that with earlier exploration and diagnosis gastro jejunostomy will be replaced to a greater extent by resection although many patients will always present themselves so late that only a palliative gastro-jejunostomy can be performed. At present many come too late for any operation.

GENERAL CONSIDERATIONS

Before describing some of the chief methods of performing the operation of gastro jejunostomy it is important to draw attention to certain points which are essential to all of them.

(1) *The opening must be large enough—at least two inches long—for a small stoma does not drain the stomach well and a short attachment of*

the engaged viscera is more likely to lead to kinking. A small opening may contract or even close as a result of gastro-jejunal ulceration. This was not uncommon after the use of the Murphy button, especially when there was no permanent narrowing of the pylorus. A very large opening is probably harmful in that it allows the stomach to empty too rapidly and in some cases helps spur formation, with obstruction and "vicious circle."

(2) **The orifice must be placed at the lowest part of the stomach as the patient stands**, for most of the food has to pass through the orifice during the day. There is much evidence to show that vomiting and recurrence of symptoms are largely due to malposition of the orifice, but the position of the opening into the jejunum is of even greater importance. It must be close, but not too near, to the duodeno-jejunal flexure.

(3) **Some of the mucous membranes of the stomach and jejunum should be removed in order to prevent valve formation.** An elliptical opening is thus made instead of a mere slit.

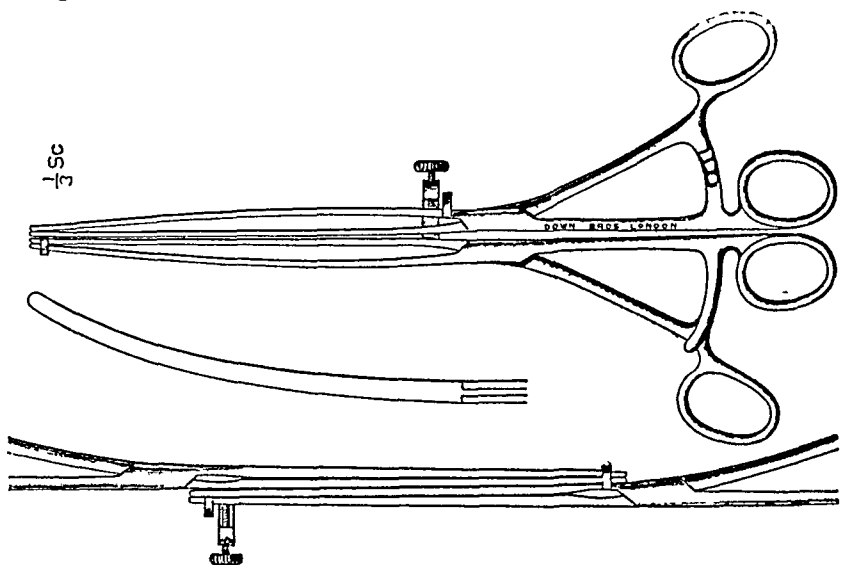


FIG. 84. Lane's Clamps (Down Bros.).

(4) **The use of Clamp Forceps.** Long clamp forceps are invaluable for this operation, for they arrest hæmorrhage, prevent any leakage and steady the parts during the operation; they also greatly facilitate the suturing. Their value is almost universally recognised, although some surgeons never use them because they are afraid of hæmorrhage, or of jejunal ulceration after their use (*see* Fig. 84). There is little fear of these, however, if the sewing is carefully done and suitably elastic clamps are used so that the mucous membrane is not damaged by them.

(5) **Sutures.** It is best to use only fine (No. 00 or 0) continuous catgut sutures properly hardened in formalin and sterilised in equal parts of tincture of iodine and water for ten days: unabsorbable sutures should not be used because they may cause ulceration. It is essential for the deep suture to pierce all the coats, so that it may not bite out before firm union has occurred and lead to disastrous leakage. The other suture is sero-muscular. A continuous running suture is far more quickly applied

than interrupted sutures and a continuous piercing suture controls hæmorrhage better than any other, and for this purpose the turns should not be more than one-eighth of an inch apart. The deep suture may be either a simple running or a mattress one, the latter secures better inversion towards the end but is less hæmostatic and more likely to cause puckering unless well applied. The knots should be upon the mucous surface.

The continuous Lembert or Cushing suture should be used to reinforce the deep one and to secure wide serous apposition and union. The suture should turn in a little more of the serous surface of the stomach than of the jejunum, so that the lumen of the latter may not be unduly narrowed or flattened.

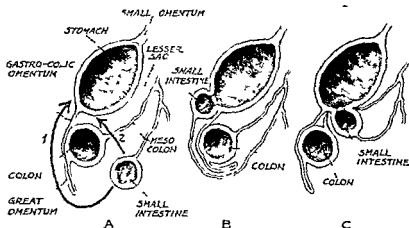


FIG. 85. Gastro-jejunostomy shown diagrammatically. A The parts are here shown in their normal relations and attitudes. The arrow 1 shows the anterior operation after the method of Wolfier that marked 2 the method of Von Hacker. B, anterior gastro-jejunostomy. C posterior gastro-jejunostomy. It will be noticed that this provides the most dependent opening both in the upright and prone positions.

(6) **The use of Packs.** It is essential to carefully pack behind and around the pouches engaged in the operation to prevent contamination of the peritoneum or parietal wound.

Different Methods. (1) *Posterior gastro-jejunostomy without a jejunal loop*, (2) *anterior gastro-jejunostomy*, (3) *Roux's Y method*, (4) *anterior or posterior loop operation with entero anastomosis*.

The Choice of Operation. It is now generally believed that the posterior no-loop operation is the best, but the reasons for this belief should be mentioned here.

(a) **Anatomical and physiological considerations.** If drainage of the stomach depends to any great extent upon gravity, it is clearly better to make the opening low down upon the posterior inferior surface than anywhere upon the antero superior surface. This is true even when the body is upright, and the advantage is greatly increased when the patient is recumbent (see Fig. 85). But the weight of the long limbs of the jejunal loop used for the anterior operation certainly drags the anterior opening downwards to some extent. It must be remembered also that the stomach is not a passive bag, and that its drainage is not entirely

dependent upon gravity. The larger the stoma, however, and the more damaged the muscular power of the stomach, the greater the advantage of securing a dependent opening. The results of the ingenious experiments of Cannon and Blake upon the healthy stomachs of animals are not strictly applicable to the diseased conditions which call for gastro-jejunosomy in man. Physiologically it is an advantage to make an opening high up in the jejunum, so that as little as possible of the small intestine may be lost for the purpose of digestion and absorption; but the researches of Paterson tend to show that absorption is hardly, if at all, diminished even by anterior gastro-jejunosomy, in which the opening into the jejunum is lowest. It is of more importance to prevent the acid chyme reaching the jejunum too low down. Therefore, upon anatomical and physiological grounds, the posterior operation without a loop is better than any anterior operation, and it is certain that the posterior no-loop operation is superior to all others because it interferes less with the normal anatomical and physiological conditions and relations.

(b) *The anterior operation may be a little easier* than the posterior no-loop operation, especially if performed by surgeons of little experience and skill, but the difference is very small, and the time saved is trivial.

A short or diseased mesocolon may occasionally make a posterior gastro-jejunosomy difficult or even impossible, and adhesion of the posterior wall of the stomach may very rarely do the same, but it is exceptional for growth or simple ulceration to affect the part of the stomach which is incised for posterior gastro-jejunosomy. When this part is affected Sherren's retro-colic anterior operation may be recommended (Fig. 101). A bulky great omentum may occasionally prolong and increase the difficulties of anterior gastro-jejunosomy; but an opening may be made in the great omentum, just below the transverse colon, to overcome this difficulty.

(c) *Regurgitant vomiting* has been more common after the anterior operation on account of the loop of jejunum between the duodeno-jejunal flexure and the anastomosis.

(d) *Intestinal obstruction*, as distinguished from vicious circle, which is a high form of intestinal obstruction, has been more common after the anterior operation. Moynihan¹ mentions three cases in which the small intestine herniated into the lesser sac through the opening made in the mesocolon during the posterior operation; but this accident can be prevented by sewing the edges of the rent to the stomach. This orifice has also contracted upon the jejunum or upon the anastomosis, but this is preventable by careful suturing, as above indicated. After the anterior operation the jejunal loop or its mesentery has compressed the colon, or *vice versâ*, and in one case both the jejunum and the colon were obstructed by mutual compression, although the anastomosis was made twenty-four inches below the duodeno-jejunal flexure. The obstruction was so complete that the intestine between the jejunal loop and the middle of the transverse colon was collapsed and almost empty. In one case quoted by Mayo the small intestine passed over the afferent jejunum and became strangulated. This accident is very unlikely after the modern posterior operation.

¹ *Lancet*, 1906, i, 1345.

(e) *Jejunal Ulcer* This has been more frequent after the anterior operation

(f) *Posterior operations* allow a more thorough examination of the posterior wall of the stomach

It may be concluded that the evidence is strongly in favour of posterior no-loop operations Therefore these operations are described first, and the procedures least recommended are described last

Posterior Gastro-jejunostomy (Von Hacker) has been very considerably modified in recent years Czerny performed the operation without a loop years ago, generally with the aid of the button and supplementary sutures, with great success Mikulicz used a transverse jejunal incision in performing the no loop operation The advantage of avoiding a loop have become widely known from the writings of Petersen, and the operation has been greatly facilitated by the aid of clamp forceps Mikulicz's method of making a transverse incision in the jejunum does not allow a large opening to be made, for it must be smaller than half the circumference of the bowel, otherwise it may lead to obstructive symptoms from kinking and valve formation This happened in four out of forty three of these operations recorded by Dr W J Mayo and four secondary operations had to be performed The opening from the stomach into the distal part of the intestine was successfully enlarged by performing Finney's operation (see p 196) on either side of the opening It was said to be impossible to make an entero anastomosis on account of the shortness of the available intestine above the gastro jejunostomy but mobilisation of the terminal part of the duodenum usually makes this possible

(1) POSTERIOR GASTRO-JEJUNOSTOMY WITHOUT A JEJUNAL LOOP

A right paramedian incision five inches long is made in the epigastrium extending down to the level of the umbilicus, the rectus being displaced outwards The stomach, duodenum, gall bladder, appendix and other organs are thoroughly examined before deciding which operation, if any, to perform Sometimes other operations such as removal of the appendix or gall stones, are substituted for or added to gastro jejunostomy I remove the appendix always if time permits, for it is almost invariably diseased in these cases The great omentum and the transverse colon and stomach are drawn well forwards with the left hand, thus making the mesocolon taut and bringing it well into view (see Fig 86) A bloodless part of the latter is selected, picked up with forceps, drawn downwards and away from the stomach and snipped with scissors The opening thus made in the lesser sac is carefully enlarged until it admits three fingers, and through it the posterior surface of the stomach is thoroughly examined The lowest part of the greater curvature vertically below the right border of the œsophagus is selected for the lower end of the anastomosis When the proper site has been noted the left hand in front is used to push a fold of the posterior wall of the stomach downwards through the opening in the mesocolon so that the right hand may grasp and pull it downwards and forwards out of the abdomen While this vertical fold, about four inches long, is held by the left hand the clamp is applied by the right hand (see Fig 87) The tips of the blades are

below the greater curvature and point to the patient's head. The handles of the clamp are then brought upwards to the right and held by an assistant. By drawing the transverse colon forwards and to the right and passing the finger backwards and to the left along the under surface of the mesocolon, the duodeno-jejunal flexure is found and the jejunum near its origin is brought into the wound. A fold of it four inches long, including the free border, is emptied and gently clamped, the tips of the blades being towards the duodeno-jejunal flexure.¹ The part to be clamped is that which can first be brought comfortably out of the wound without

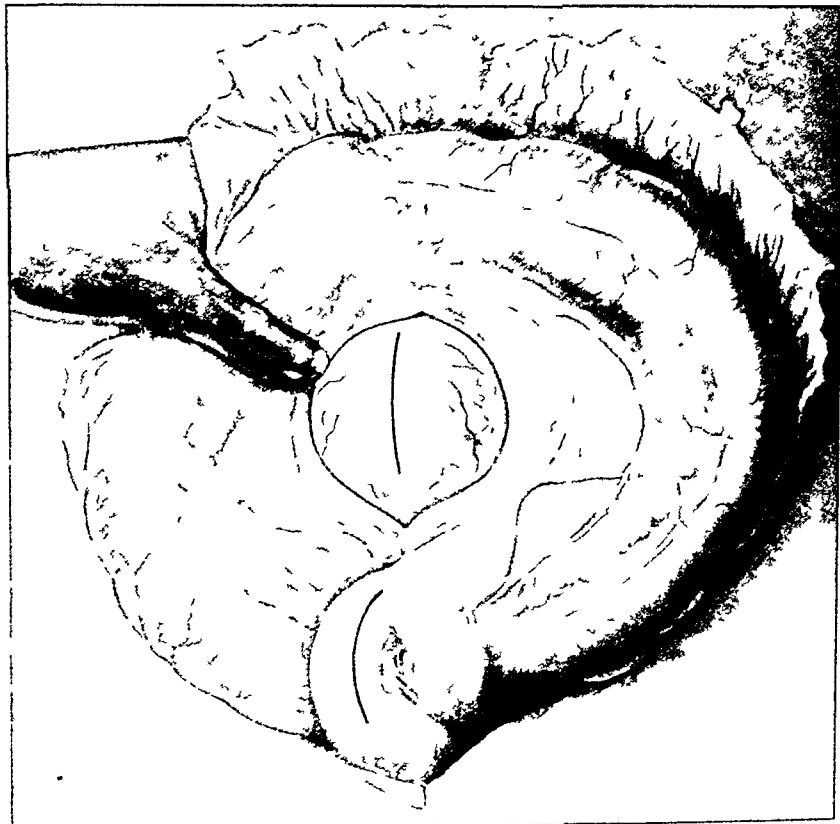


FIG 86 Posterior gastro jejunostomy The opening in the transverse mesocolon is shown and the sites of the incisions to be made in the stomach and jejunum The suspensory ligament at the duodeno-jejunal flexure is shown just above the jejunal incision

either slackness or undue tension. It is most important to make the anastomosis in the best place, neither too high nor too low in the jejunum. In order to avoid obstruction from kinking, torsion or traction, it may be necessary to separate adhesions between the early part of the jejunum and the mesocolon (*see* Fig. 88). The protruding portions of the omentum, colon and excess of jejunum are returned into the abdomen to avoid undue

¹ Dr. W. J. Mayo prefers to place the forceps with their handles to the right, because it is easier to apply them, but it is an advantage to have the handles of the gastric and jejunal clamps directed in opposite directions, for they balance better and do not require holding.

exposure and distension. A long strip of gauze moistened with hot saline solution is now placed between the two clamps which are afterwards closely approximated and locked in position so that the assistant may be free to assist in other ways (see Fig 89). Large warm moist pads are now arranged around and under the clamps so as to isolate the clamped pouches and protect the wound from infection (see Fig 90).

A continuous sero muscular suture of strong fine catgut (No 00) is now used to join the adjacent edges of the two viscera for a distance of at least three and a half inches. It is begun on the left where the tail of the

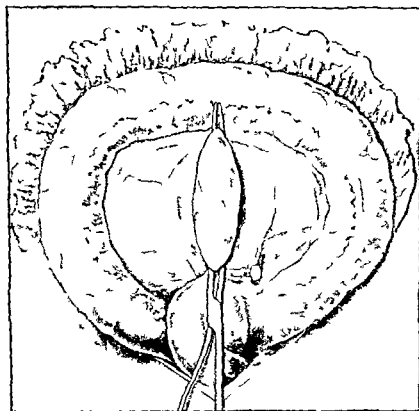


FIG 8 Posterior gastro-jejunostomy. The clamp is applied to the stomach so that its point is below the greater curvature.

knot is held with forceps. The thread should be always held taut to secure close approximation and to raise a fold of sero muscular tissue after each stitch for this simplifies the introduction of the next one (see Fig 91).

When the first half of this superficial suture has been inserted the serous and muscular coats of the stomach and jejunum are incised so as to expose and liberate the mucous membranes which pout into the wounds. An elliptical piece of mucosa about two and a half inches long and a quarter of an inch wide is excised with scissors in one piece from the stomach. A smaller piece is removed from the jejunum but this is not

so easy and often has to be done piecemeal (*see* Fig. 92). The incision thus made should be a quarter of an inch in front of and parallel to the posterior sero-muscular suture-line. The assistant mops up any escaping contents of the pouches and carefully dries each pouch. The contaminated mops are thrown away at once.

The gastric mucous membrane is prevented from retracting by means of tissue forceps, if necessary.

Reliable and strong catgut¹ should be used for the deep suture, which pierces all the coats. It should be commenced at the left extremity

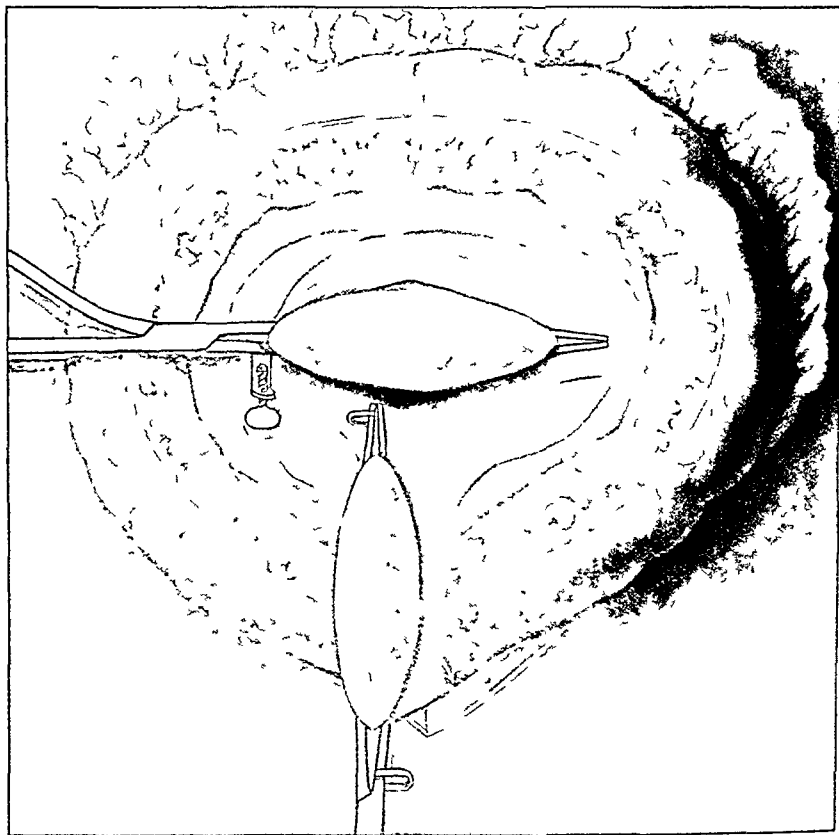


FIG 88 Posterior gastro-jejunostomy The gastric clamp is rotated so that its end points to the left The jejunal clamp has been applied with its point close to the duodeno-jejunal flexure; its handles are soon turned to the left, and the two clamps are locked, so that they balance each other.

of the anastomosis. The knot is placed upon the mucous surface and the tail thread is held with forceps (*see* Fig. 93). Tissue forceps applied at the right ends of the wounds hold the jejunum and stomach together and well up and make the sewing easier. The suture is continued and completed as a running or overstitch, but, at the right extremity of the stoma, a loop is taken on the mucosa to turn the corner so that the suture can be more easily completed, *i.e.* with the curved needle passing towards instead of away from the surgeon (*see* Figs. 94 and 95). Tissue forceps

¹ Formalin iodine catgut, size No 00, lasting about twenty days

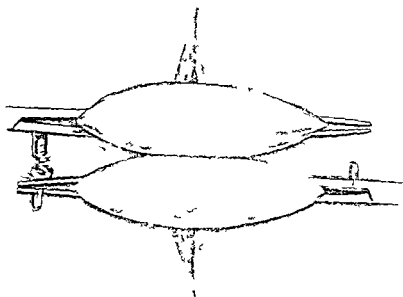


FIG 89 Posterior gastro jejunostomy A strip of moist gauze is placed behind and between the clamps which are brought together with the points in opposite directions The jejunal clamp is sheathed with rubber tubing



FIG 90 Posterior gastro-jejunostomy The clamps are locked and the pouches of the stomach and jejunum are completely packed off

are applied near the left end of the anastomosis to hold the anterior lips of the wound accurately together. Both knots should be placed upon the mucous surface in the manner described later.

Care must be taken to keep the thread always taut, and the turns

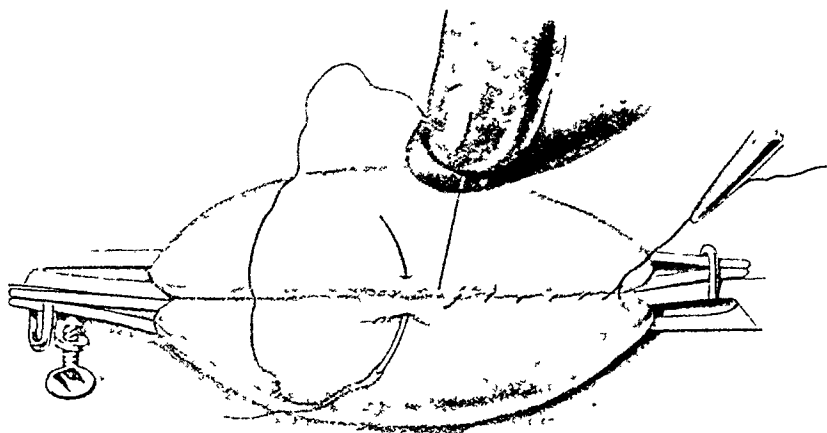


FIG 91. Posterior gastro jejunostomy. The first or sero-muscular suture started on the left and continued to the right extremities of the pouches.

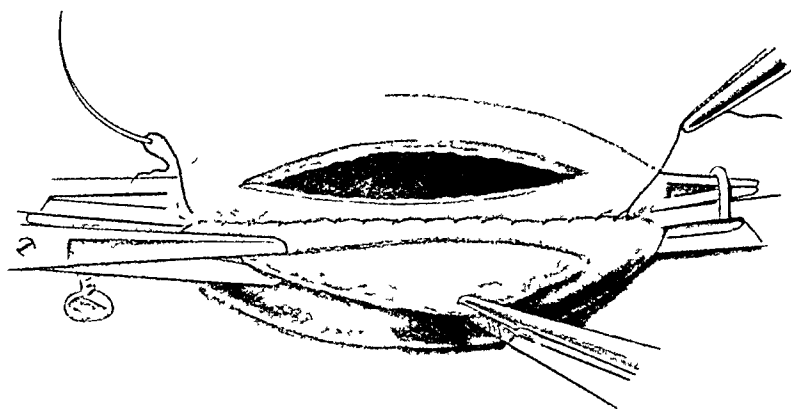


FIG 92. Posterior gastro jejunostomy. The prolapsing mucosa of the jejunum is being removed with scissors. The stomach has been similarly treated.

should not be more than one-eighth of an inch apart. These precautions secure accurate apposition of the mucous membranes, and especially prevent hæmorrhage. The clamps are now removed, and if the deep suture has been properly applied very little bleeding occurs. An additional turn or two of suture is applied at any bleeding spot. The exposed parts

are cleansed with moist sterile swabs. All instruments and pads which may have been contaminated from the mucous membranes are discarded. The gloved hands are washed in lysol 1 in 100 and rinsed in saline, and two clean towels are placed around the wound. The sero muscular

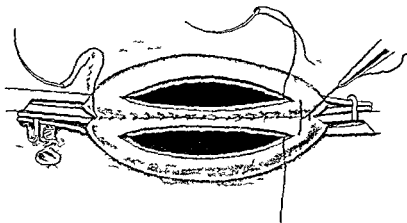


FIG. 93. Posterior gastro jejunostomy. Note the mode of starting the second or perforating suture.

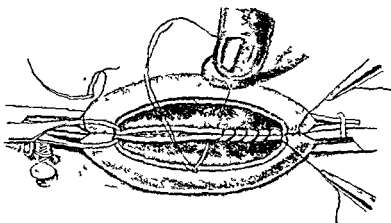


FIG. 94. Posterior gastro jejunostomy. The perforating suture is always drawn and held taut to prevent hæmorrhage when the clamps are removed.

suture is now continued after the method of Lembert or Cushing. The latter leaves none of the thread exposed and therefore lessens the chance of adhesions. When the circle is nearly complete the assistant holds up the tail thread at the starting point while the surgeon carries the last turn of the suture beyond this point, the two ends are then tied together.

The whole circle of union is now examined, and if necessary a reinforcing suture may be placed at any weak spot (*see* Fig. 97).

The gauze packs are removed and the parts cleansed. The transverse colon is brought out again and drawn forward so as to expose the gap

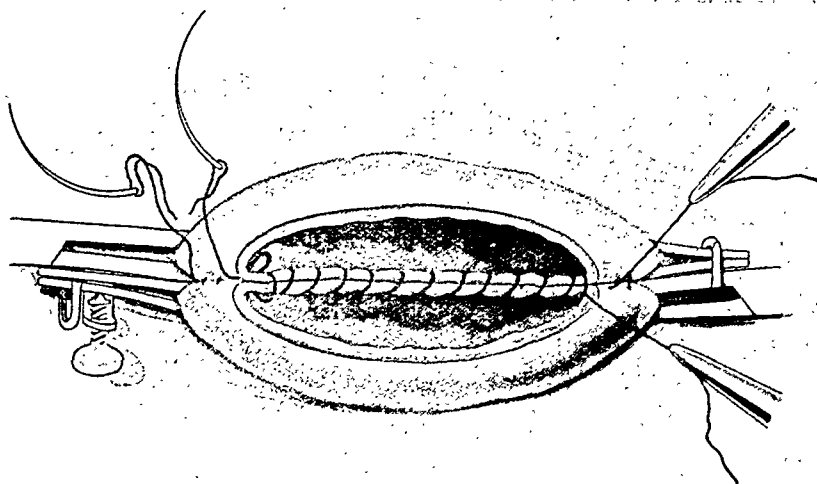


FIG. 95. Posterior gastro-jejunostomy. The perforating suture is well advanced. Note the mode of "turning the corner."

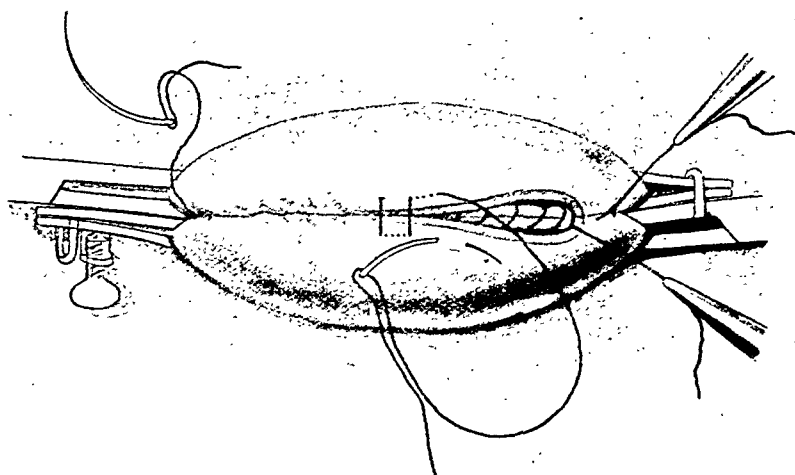


FIG. 96. Posterior gastro-jejunostomy. The perforating suture is nearly completed after Connell's method. The knot is placed within the lumen.

in its mesentery to enable the surgeon to fix its margins to the stomach (*see* Fig. 98). Failure to do this may lead to the formation of an internal hernia. Five sutures are sufficient, one in front and two at each side. Mattress sutures are used and passed in such a manner that they turn the sub edges of the rent upwards into the lesser sac so as to lessen the risk of lesions below with kinking of the jejunum. The mesocolic vessels

must be carefully avoided. These sutures pick up the stomach half an inch away from the anastomosis, so that adhesions and contractions may not disturb the stoma.

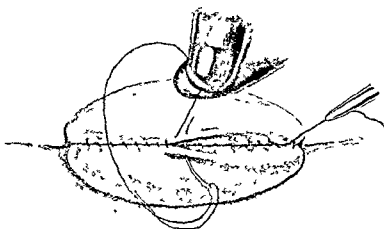


FIG 97 Posterior gastro jejunostomy. The continuous seromuscular suture is nearly completed.

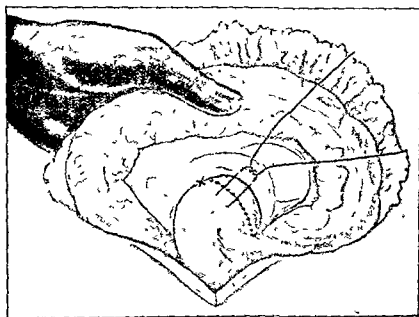


FIG 98 Posterior gastro jejunostomy. The opening in the mesocolon is closed. It is better to sew the margins to the stomach.

Mayo's Method of Posterior Gastro jejunostomy without a Loop. In the old no loop operation of posterior gastro jejunostomy the part of the jejunum engaged in the anastomosis was turned to the right so as to be iso peristaltic with the stomach. The results were, on the whole, good,

but Dr. W. J. Mayo¹ published two cases in which chronic bile regurgitation of a serious character developed. In each of these "the occasional regurgitation of quantities of biliary and pancreatic secretions was a source of great discomfort and considerable disability. Reoperation in both cases showed that the cause of the trouble was an angulation of the jejunum at its gastric attachment." These troublesome symptoms occurred at two out of fifty-six no-loop operations performed between January 1 and July 1, 1905, with one death. Dr. Mayo soon gave up the iso-peristaltic method. He maintained that the jejunum normally



FIG 99. Posterior gastro jejunostomy The opening in the stomach is vertical and in a line with the right border of the œsophagus, it is at least two and a half inches long The opening in the jejunum is near, but not too near, the duodeno-jejunal flexure

ascends a little from its origin towards the left and then falls downwards and backwards towards the left kidney pouch. If the bowel is turned well to the right kinking may occur at the anastomosis.

The only essential difference from the usual no-loop operation as described above is that the incision in the posterior wall of the stomach runs obliquely downwards and to the left instead of vertically downwards, so that the attached jejunum may also run downwards and to the left (see Fig. 100).

(2) ANTERIOR GASTRO-JEJUNOSTOMY

After the stomach has been thoroughly examined, the lowest part of the greater curvature is selected. Long curved clamp forceps are applied

¹ *Ann of Surg*, 1906, xlin, 537

obliquely with their handles towards the left shoulder and their points below the greater curvature near the pylorus. The fold included in the forceps should be four inches long and empty.

The duodeno jejunal flexure is found in the way already described, and the jejunum is traced downwards for about eighteen inches, where

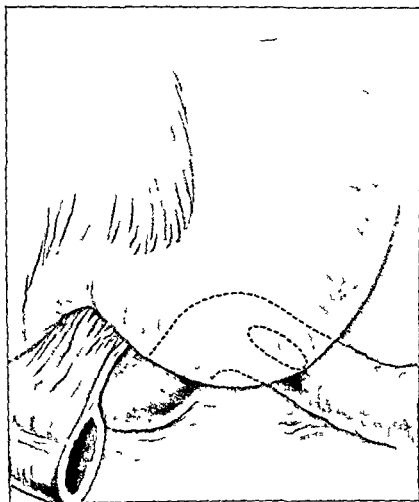


Fig. 100. Posterior gastro-jejuno-stomy after Mayo's method. The stoma is too small and too far to the left. (After Mayo, *Ann. of Surg.*)

it is clamped and joined to the stomach. It is important to trace the bowel from its origin¹.

The selected loop of jejunum should be so arranged that its distal part may be nearest the pylorus and lowest upon the stomach so that drainage into the proper limb may be facilitated. The details of suturing are the same as already described.

To prevent kinking a few sutures should be inserted to fix the proximal limb of the jejunum to the stomach above and to the left of the anasto-

¹ If the piece of small intestine which emerges below the colon be chosen, it may prove to be in the ileum (Mr. H. W. Page, *Med. Chir. Trans.*, lxxii, 379).

mosis. This can be done by carrying the sero-muscular suture well beyond and to the left of the stoma. To prevent rotation the opening in the jejunum must be on the side of it lying in contact with the stomach and

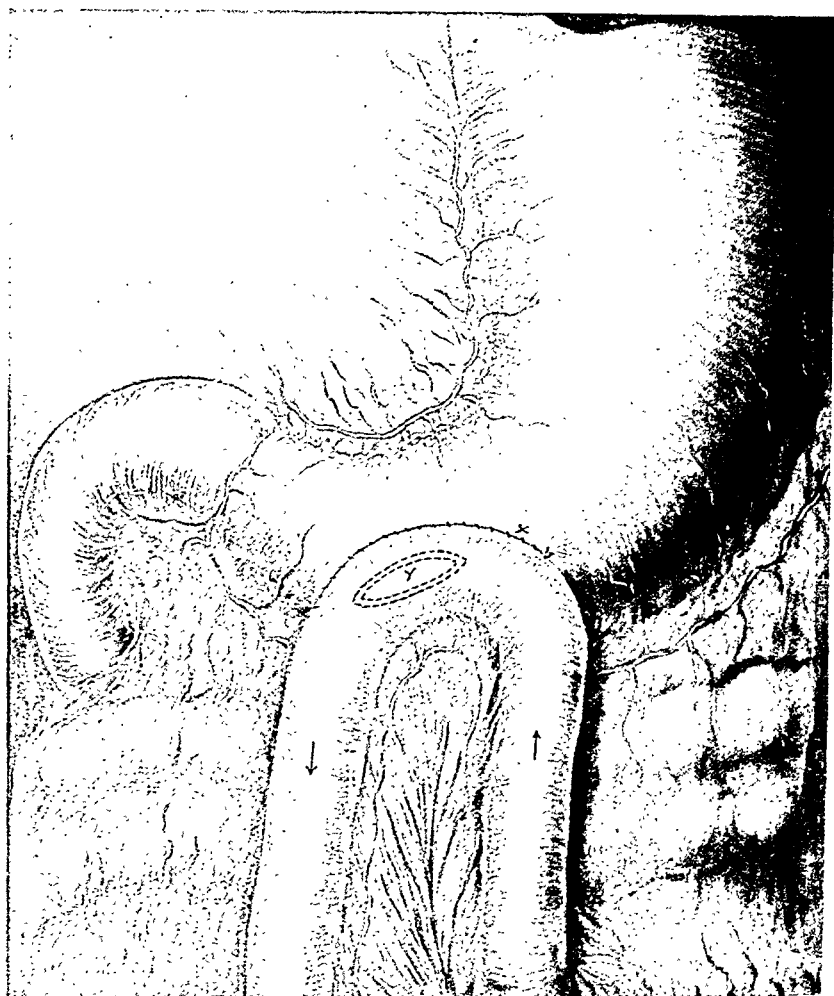


FIG. 101. Anterior gastro-jejunostomy. The jejunal loop is brought up in front of the great omentum and transverse colon without compressing the latter. The stoma is at the lowest part of the pyloric segment of the stomach; it should be made longer and placed vertically. Kinking at the stoma is avoided by an extensive attachment of the jejunal loop to the stomach. The proximal limb must be long enough to allow of some shrinkage without causing obstruction of either the jejunum or colon.

not on the free border. It is important to make the opening low enough in the jejunum to allow easy approximation of the parts without tension, and without compression of the colon. The afferent limb of the loop often shortens after the operation, thus adding to the risks of compression of the colon and kinking of the jejunum, if the loop is short. On the other hand, the chosen spot must not be low enough for the loop to produce a potential hernial aperture (see Fig. 101).

In some stout patients with bulky great omentum an opening may be made in the latter to allow the proper part of the jejunum to be brought

to the stomach without tension and without troublesome folding of the omentum

(3) GASTRO JEJUNOSTOMY WITH ENTERO ANASTOMOSIS (Braun Jaboulay and Weir)

Entero anastomosis is sometimes added to gastro jejunostomy to prevent regurgitant vomiting from kinking of the jejunum. It is not often necessary especially with the posterior operation. Moreover it

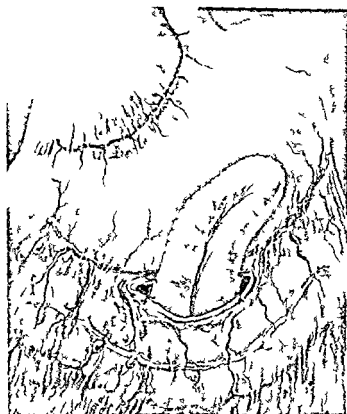


FIG. 10 Retro colic anterior gastro jejunostomy (after Sherren)

makes the operation more complicated and prolonged and may add to the risk of jejunal ulceration but if the parts do not lie well and vicious circle is feared it is wise to make an entero-anastomosis. It is also indicated in most cases of anterior gastro jejunostomy for irremovable carcinoma of the stomach for in these cases vomiting is a frequent cause of death unless this precaution is taken. Balfour makes use of this plan after joining the jejunum to the stomach in front of the colon when performing gastrectomy.

COMPLICATIONS AND SEQUELÆ OF GASTRO JEJUNOSTOMY

Fortunately these are rare at the present day owing chiefly to the great improvements in the technique of the operation and to a lesser

extent, to the greater care in the preparation and after-treatment of the patient, and also to the more accurate knowledge of the indications for and against operation. But even with the greatest care complications do occasionally arise, so that a careful consideration of them is essential. Only those peculiar to this operation will be considered here, for those common to all abdominal operations have been discussed in Chapter I.

(i) **Hæmorrhage.** Serious bleeding very rarely occurs, but when it does it generally comes on within twenty-four to forty-eight hours of the

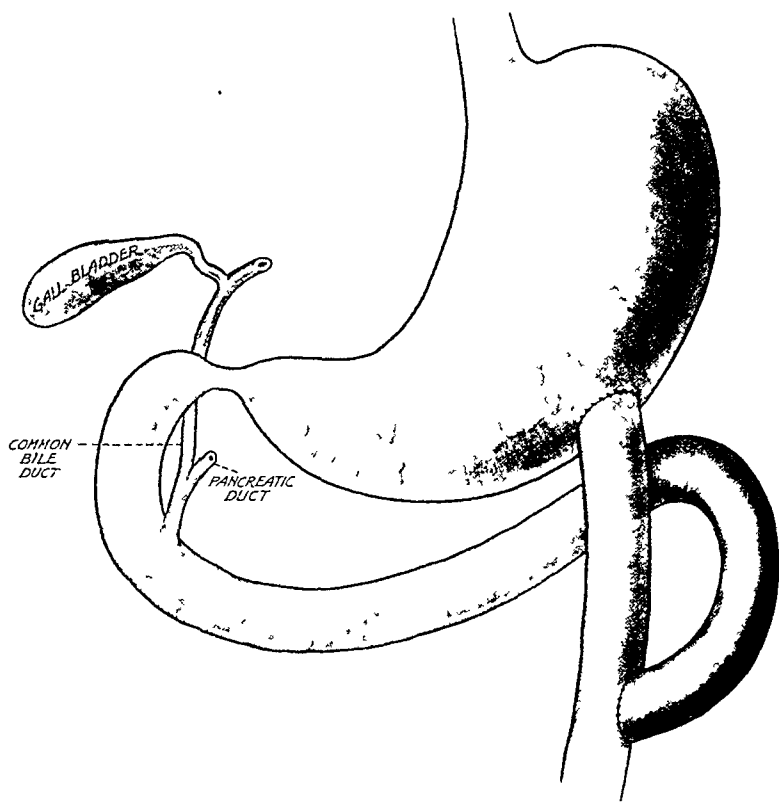


FIG. 103. Roux's Y method of gastro-jejunostomy. The opening in the stomach may be either anterior or posterior, preferably the latter.

operation. It may take place from the anastomosis, from the ulcer or from damaged gastric mucous membrane. It is nearly always due to imperfect sewing, and is therefore avoidable by great care in applying the deep continuous suture. The turns of this should be so close together and drawn so tight as to prevent the possibility of bleeding. Care must be taken to pick up all the coats at each turn. Some surgeons believe that the bleeding is due to the use of clamps, but I am convinced that it is due to imperfect sewing. Strong clamps roughly used may damage the mucous membrane at the line of their application, and this may lead to hæmorrhage; but only elastic or rubber-covered clamps should be used, and they should be gently but firmly applied. Similarly, to avoid bleeding from the ulcer, the greatest gentleness must be used in handling it and, when

bleeding has been a prominent sign before the operation special precautions must be taken against reactionary and secondary hemorrhage

After the operation it is not wise to raise the blood pressure too much, especially in old people

Treatment When bleeding does occur in any serious quantity it soon causes vomiting and pain from distension of the stomach All liquids

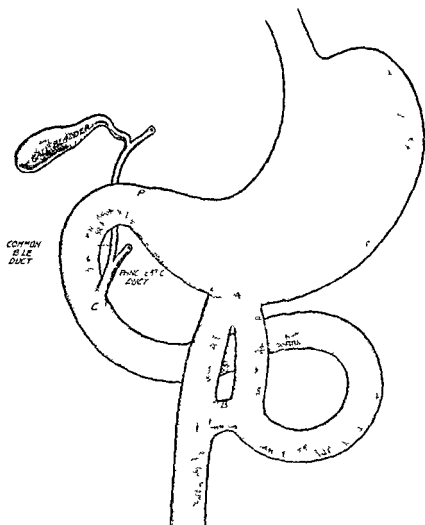


FIG 104 Gastro jejunostomy with entero anastomosis

by the mouth are at once stopped an injection of morphine gr $\frac{1}{4}$ is given to ease pain keep the patient at rest and to lower the blood pressure and the stomach is washed clean with a soft tube The patient rarely succeeds in emptying and cleaning his stomach by vomiting and very soon the blood decomposes and may even send the temperature up or cause diarrhoea Moreover distension of the stomach is a potent cause of the continuance of bleeding Hence it is necessary to use the stomach tube

which can do little harm. About 4 ounces of sterile water, containing 2 drams of 1 in 1,000 solution of adrenalin chloride, are left in the stomach.

(ii) **Regurgitant Vomiting.** Vomiting is exceptional after the modern operation, especially when the oblique or sitting up position is adopted. In a few cases, however, vomiting of a serious character develops either within a few days or weeks of the operation. Bileous fluid regurgitates in large quantities at various intervals, usually without apparent effort or

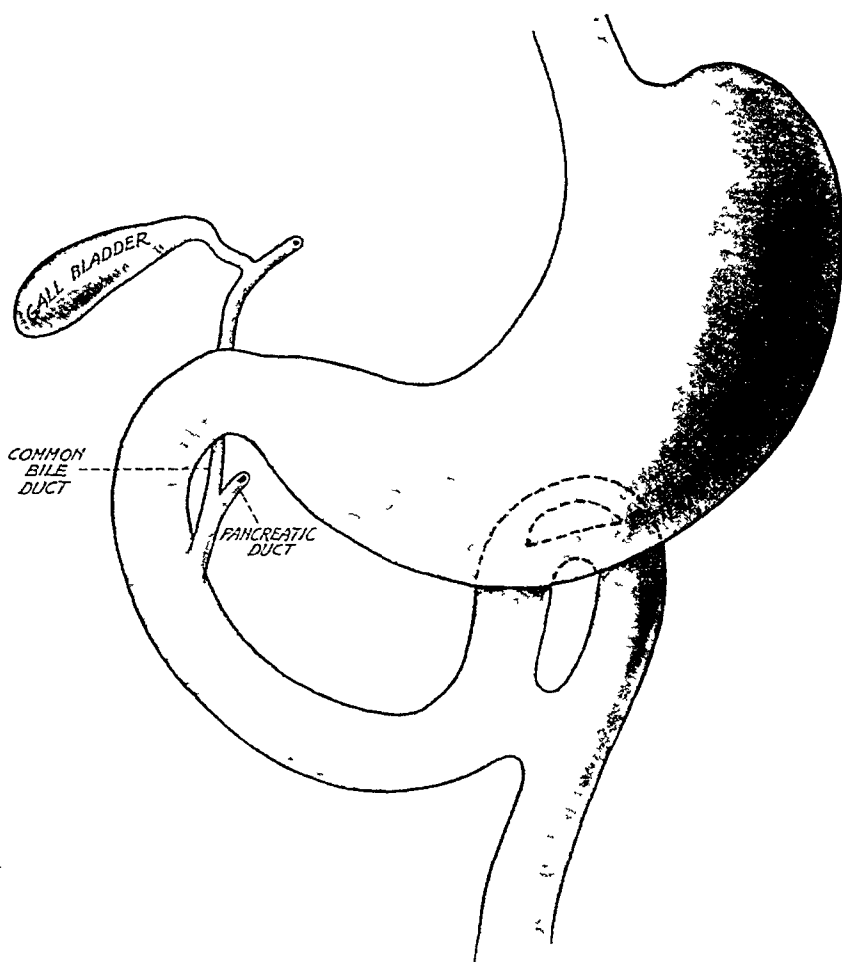


FIG 105. Entero anastomosis for vicious vomiting occurring after the modern posterior operation. This may be very difficult

pain. This is due to intestinal obstruction at the anastomosis. This may be early and complete, when it rapidly leads to death unless relieved by operation (acute vicious vomiting), or it may be partial and slow of development, vomiting occurring only about once every two or three weeks.

Occasionally early vomiting is due to temporary swelling with valvular formation at the anastomosis which is too small, with paralytic distension of an overloaded stomach. The stomach may be distended with bile and

pancreatic juice or food. Washing out generally stops the vomiting at once but it may have to be repeated several times. Sometimes vomiting continues for several days in very nervous women without any obvious cause.

In nearly all cases vomiting is due to faulty technique resulting in obstruction of the jejunum. This may consist of angulation flattening or rotation of the bowel at the anastomosis obstructing either the afferent or efferent limb or both (see Fig. 101). All degrees of obstruction occur, slight degrees do not cause vomiting or other symptoms except in nervous patients. Complete or nearly complete obstruction causes severe epigastric pain and frequent vomiting with intolerable thirst and all the signs of a high intestinal obstruction. Acute regurgitant vomiting was not uncommon after the anterior operation and led many surgeons to perform entero-anastomosis as a routine measure in order to prevent it. Chronic vicious vomiting is more common after posterior operations and may require the formation and contraction of adhesions about the anastomosis and mesocolon for its full development. It is often due to the opening in the jejunum being a little too low so that a loop is left between the duodeno-jejunal flexure and the anastomosis. It has also been shown to be due to ascent of the jejunum at the anastomosis into the lesser sac with a retracting stomach kinking the duodeno-jejunal flexure or the opening in the mesocolon has contracted round the bowel producing an abrupt kink. It is often due to inflammatory shortening and tension upon a too short proximal jejunum with kinking at its attachment to a retracting stomach thus making a spur at the anastomosis. Of recent years this has seemed to me to be the commonest cause of vicious circle the opening having been made too high in the jejunum.

In a normal individual the passing of bile and pancreatic juice into the stomach without retention there does not cause vomiting but it may do so in a nervous patient.

Generally the afferent limb of the jejunum is obstructed at or near the anastomosis and it becomes dilated and cedematous. An X-ray examination may demonstrate the obstruction but it is often misleading perhaps showing the opaque meal passing fairly freely into the distal jejunum. In other cases it may demonstrate duodenal ileus as the cause of the vomiting the superior mesenteric vessels compressing and obstructing the third part of the duodenum¹.

Treatment. Lavage should be tried without delay and continued if necessary. It is often effectual and the semi prone position often helps. Irrigation of fluids by the mouth small doses of pituitary extract or strychnine and rectal salines are also indicated. Failing relief in this way an operation must be performed for severe vomiting without delay. The exact cause and position of the obstruction must be found. When the jejunum is obstructed at or near the stoma an anastomosis is made between the afferent and efferent jejunum as far away from the anastomosis as the length of the afferent limb will allow. After the modern operation this may be difficult. Mobilisation of the fourth part of the duodenum after dividing carefully the peritoneum to the left of it facilitates the operation.

¹ A. F. Hurst *Guy's Hosp. Reports* 1922, No. 4 lxxi, 436 and *Ibid.*, 1926 lxxvi, 156.

² After washing clean continuous aspiration with Sprungel's pump and a Ryle's small tube is invaluable.

Although this has nearly always relieved, it has not always cured, for some of the contents of the afferent jejunum can still reach the stomach. Tying the afferent limb above the entero-anastomosis and infolding the ligature is a simple way of adding to the efficiency of the operation. The most certain way, however, is to divide the afferent limb just below the gastro-jejunostomy, close its gastric end, and implant its duodenal end into the side of the efferent limb, four inches below the stomach, after Roux's method. One of us¹ has found this method very effective in these cases. When the duodenal ileus is the cause of the vomiting, as shown by X-rays and exploration, the distal limb of the jejunum is brought over the spine to the right and joined by lateral anastomosis to the dilated part of the third portion of the duodenum.

(iii) **Intestinal obstruction** of a different kind may occur sooner or later after gastro-jejunostomy, but it is not always due to the operation. The small intestine has herniated through the mesocolon into the lesser sac: this can be prevented by closing the opening with sutures. The small intestine has passed from either side above the proximal limb of the jejunum, its mesentery thus entering a ring formed by the jejunum, transverse mesocolon, anastomosis and spine: this can be prevented by placing the opening in the jejunum high enough and by suturing the afferent jejunum to the mesocolon. When a loop is left between the end of the duodenum and the anastomosis it may pass between the mesentery of the jejunum engaged in the anastomosis and the transverse colon, where it may get obstructed.

(iv) **Jejunal ulcer or gastro-jejunal ulcer.**² After gastro-jejunostomy for non-malignant disease ulceration may ensue in about 3 per cent. of the cases at or near the stoma, generally in the efferent part of the jejunum within four inches of the stoma. At the Mayo clinic Eusterman³ found it was seven times as common in men as in women, although gastro-jejunostomy was performed only three times as often in men as in women, and mostly follows when the operation has been performed for duodenal ulcer. It is significant that it rarely follows gastro-jejunostomy for gastric ulcer in which there is usually no over-acidity. It has hardly ever been known to follow gastro-jejunostomy for malignant disease, probably due to the deficiency of free hydrochloric acid in the gastric juice in this disease. It is particularly liable to follow when some of the jejunal mucosa is exposed to the undiluted and over-acid gastric juice. Inaccurate apposition of the mucosa, leaving a raw surface, is especially to be avoided. It is more likely to follow when the stomach is ill drained and over-acidity persists, and therefore a small or ill-placed stoma aids its formation. The careless use of unprotected clamps, especially on the jejunum, may cause bruising or laceration and lead to the development of jejunal ulcer. It may follow the modern no-loop operation performed with the greatest care, for a good deal depends on the preparation and after-treatment, neglect of which may reproduce the causes of the original ulceration of the stomach or the duodenum. It is most important to eliminate all sources of septic infection, such as oral and nasal sepsis, chronic appendicitis or cholecystitis. The too early return to work and

¹ R. P. Rowlands, "Vicious Circle," *Guy's Hosp. Reports*, 1922, lxxi, 68.

² A. F. Hurst and R. P. Rowlands, *Guy's Hosp. Reports*, 1921, lxxi, 319.

³ *Collected Papers Mayo Clinic*, 1919, xi, 52.

solid irritating food may delay the healing of the wound and lead to ulceration at the stoma. The use of unabsorbable sutures may similarly delay the healing of the stoma; therefore only fine catgut should be used. One of us (R. P. R.) has removed both the sero-muscular and the deep continuous sutures of linen thread three and a half years after the gastro-jejunostomy. Medical treatment should be thoroughly tried such as complete rest in bed for several months, careful dieting and the administration of alkalis. Failing these a radical operation should be performed. The treatment of perforation has been discussed at p. 122.

Radical Operation. This may tax the skill, ingenuity and resource of the best surgeon owing to extensive adhesions, bleeding, the obscure relations of the affected parts and the poor condition of the patient.

The following account is taken from the Guy's Hospital Reports.¹

'It is wise to insist on complete rest in bed and careful medical treatment for at least a week before the operation which may be a difficult and prolonged one. *The ideals are to excise the ulcer, provide free drainage of the stomach and restore as far as possible the normal anatomical and physiological conditions.* The preliminary radiographic examination may have shown that nearly all the food leaves the stomach through the pylorus and at the operation the pylorus and duodenum may be found to be patent, any previously existing ulceration having healed without causing obstruction. Under these circumstances the gastro-jejunostomy should be abolished, the ulcer excised and the opening in the jejunum closed without narrowing its channel. This should also be done when the primary operation was improperly performed for gastric symptoms without structural alteration of the stomach or duodenum. Any operation that adds further anatomical or physiological complications is to be avoided. The addition for instance of another gastro-jejunostomy in the hope that freer drainage of the stomach may induce the ulcer to heal is doomed to failure. It is far better to excise the ulcer although this may appear more difficult and dangerous, especially when the gastro-jejunostomy is of the posterior type. A long vertical left paramedian incision is made in the epigastrium extending below the umbilicus.

'The operation should commence as a rapid exploration of the abdomen and any primary source of infection which may be discovered such as a diseased appendix or gall bladder should be removed. The stomach, duodenum and the stoma should be carefully examined for signs of ulceration and obstruction. Dense adhesions may make this preliminary step difficult, and it is easy to overlook a small ulcer especially on the posterior surface of the stoma.

The stoma is often narrow and sometimes very small. Occasionally it is normal in size but the jejunum is knicked or twisted by adhesions so that the food which has been shown by the X-rays to leave the stomach in a normal manner does not pass freely along the jejunum. When the ulcer has been found the adhesions should be separated or divided and the parts carefully freed, identified and brought forward into the wound.

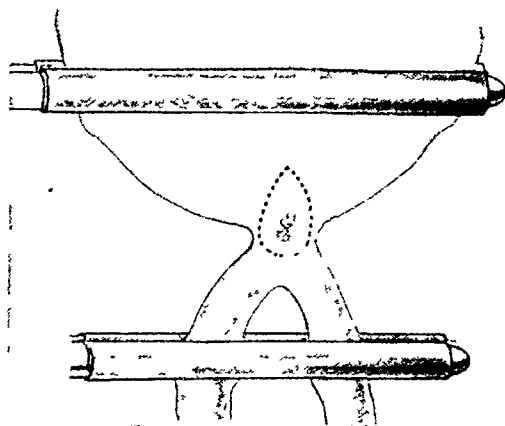
This important step is often tedious and difficult especially when the ulcer is posterior and invading the pancreas. Division of the posterior parietal peritoneum greatly facilitates the mobilisation but some of the invaded pancreas may have to be removed with the ulcer. A rubber

¹ A. F. Hurtt and R. P. Rowlands *loc. cit.* p. 331.

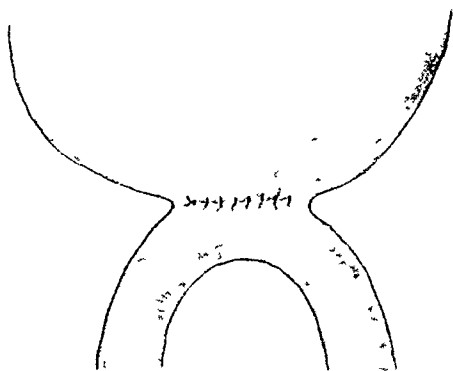
cushion behind the back helps to bring forward the lumbar spine and makes the dissection easier.

“Having separated, brought forward and clamped the parts concerned in the anastomosis, the most suitable treatment is more easily decided.

“(a) If the ulcer is small and not encircling the stoma, it is often possible to excise it and to sew up the resulting wound in such a way as to enlarge the stoma or jejunal channel (Fig. 106).



A



B

FIG 106 Excision of a gastro-jejunal ulcer with enlargement of the stoma Fig A indicates the lines of incision Fig B the method of suture.

“(b) If the ulcer is large or encircles the stoma, which is often contracted, it is necessary to excise the ulcerated area, thus detaching the jejunum from the stomach. A more perfect gastro-jejunosotomy can then, if necessary, be performed.

“(c) If the pylorus and duodenum are healthy and patent, as occasionally happens, it is not necessary to remake the gastro-jejunosotomy; it is better to close the openings in the stomach and the jejunum, thus re-establishing the normal anatomy and physiology of the parts.

(d) If the original gastro jejunostomy was anterior, it is sometimes possible to perform gastro duodenostomy making use of the opening left in the anterior wall of the stomach after excision of the ulcer (Figs 108 and 109). The opening in the jejunum is then closed without narrowing the lumen. The result in one of my cases has remained very satisfactory for ten years. After this operation recurrence of ulceration at the stoma is very unlikely owing to the free admixture of the alkaline duodenal secretions with the gastric juice.

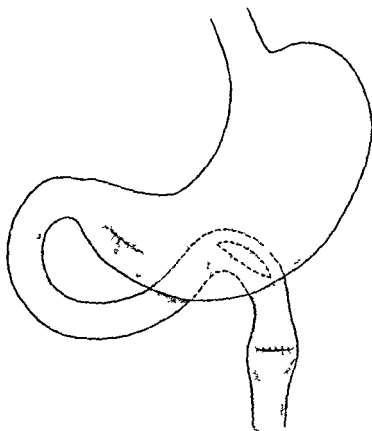


FIG 107 Radical operation for gastro jejunal ulcer. The openings in the stomach and jejunum were closed and a posterior gastro jejunostomy performed.

(e) When the pylorus is stenosed Finney's operation of pyloroplasty has been performed for similar reasons the ulcer being excised and the openings in the stomach and jejunum closed.

(f) Sometimes a gastro jejunal ulcer may be approached and excised through an opening in the anterior wall of the stomach.

(g) If the ulcer is large and on the mesenteric border of the part of the jejunum engaged in the anastomosis it may be necessary to excise the length of the jejunum thus engaged and to make a new gastro jejunostomy after Roux's method but recurrence of ulceration may occur and actually happened in a case reported by Moynihan¹. It is therefore

¹ *Brit Med Journ* 1919 ii 33

better to abolish the gastro-jejunosomy, enlarge the pylorus, if necessary, and restore the channel of the jejunum.

“(h) Partial gastrectomy has been recommended and performed for gastro-jejunal ulcer and its complications. D. C. Balfour¹ reports twelve cases without a death, and with good functional results.

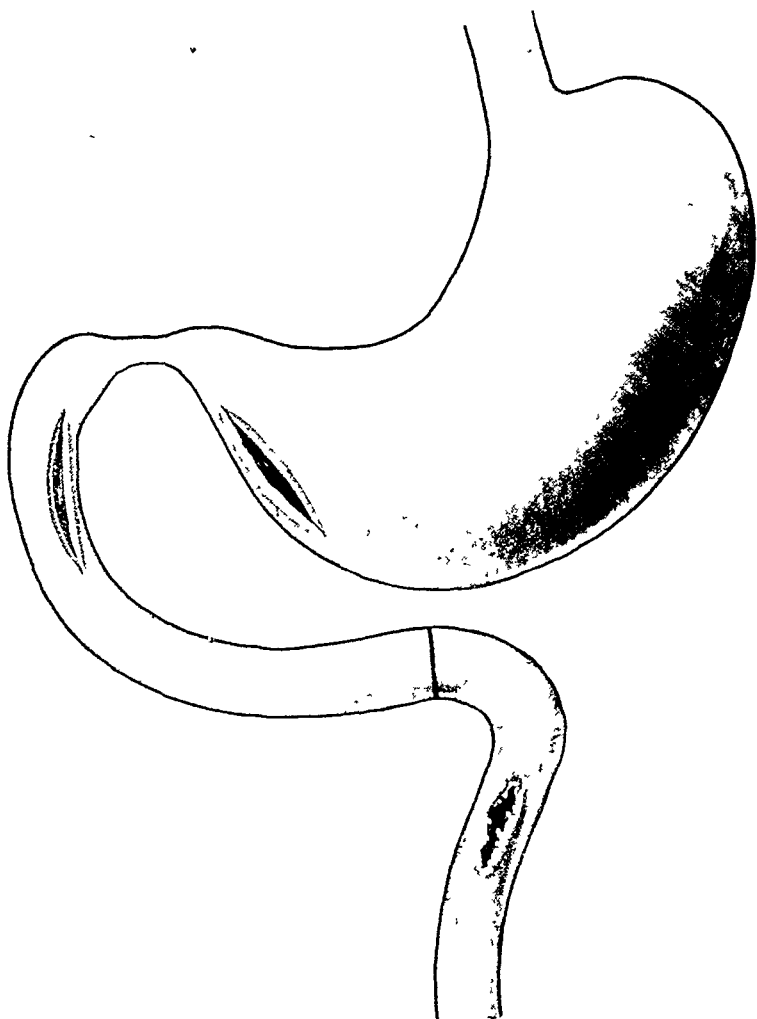


FIG. 108. Radical operation for gastro-jejunal ulcer. The jejunum was detached and closed, and gastro-duodenostomy performed. The old gastric opening was pared.

“The operation mortality in Eusterman’s² eighty-four cases from the Mayo clinic was 4 per cent., but only about 30 per cent. were cured or greatly improved, so that the results of surgical treatment cannot be regarded as very satisfactory, but they ought to improve.

“**Gastro-jejuno-colic fistula.** When the ulcer has perforated into the colon, early surgical treatment is imperative, but it is beset with

¹ *Collected Papers of the Mayo Clinic*, 1923, xv, 114.

² *Collected Papers of the Mayo Clinic*, 1919, xi, 58.

difficulties and the general condition of the patient is often very bad. Under these circumstances it is tempting to perform another gastro jejunostomy in the hope that the free drainage of the stomach thus provided may allow the ulcer to heal but experience shows that this plan is not likely to succeed. The only satisfactory treatment is to separate

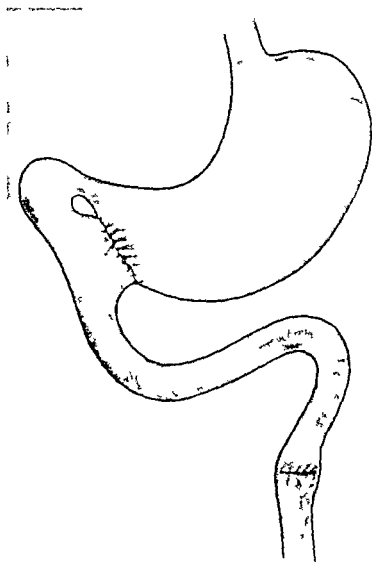


FIG. 109. Radical operation for gastro jejunal ulcer following anterior gastro jejunostomy.

the colon, close the opening in it, and then excise the ulcer and enlarge the gastro jejunostomy opening (Fig. 110). This has proved entirely satisfactory in one of my patients who has remained well for over five years. Two other patients died: in one case an anterior gastro jejunostomy failed to give any relief; in the other the ulcer had opened into

the colon and ileum, kinking the latter and causing intestinal obstruction which was relieved by entero-anastomosis, but wasting continued and the man died about three weeks after this operation."

(v) **Diarrhoea.** This sometimes follows gastro-jejunostomy in feeble marasmic patients, usually the subjects of malignant disease. It is probably infective in origin and is chiefly due to the decomposition of the products of the new growth.

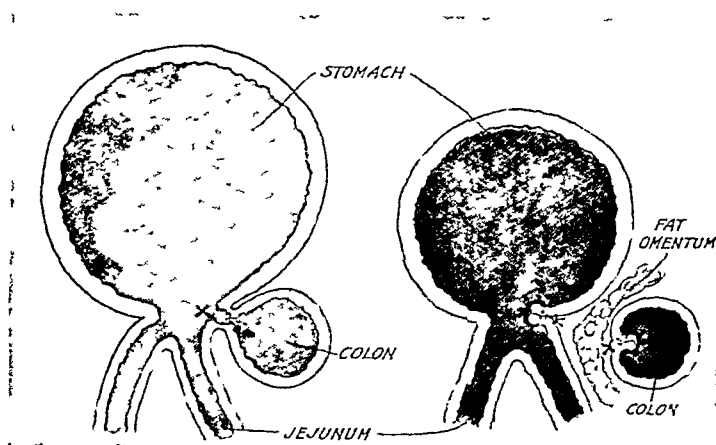


FIG. 110. Gastro-jejunocolic fistula. Sections of stomach, jejunum and colon, showing treatment of gastro-jejunocolic fistula. The fistula at X is excised, the stoma enlarged, the colon closed and separated from the stomach by omentum.

Results¹ of Operations for Gastric and Duodenal Ulcers. Statistics are so often complicated and misleading that I may be excused from quoting a mass of figures. My readers may be grateful if I give my own conclusions concerning the immediate and remote results that may be expected by a good and careful surgeon :

A. Mortality.

	Per cent.
Gastro-jejunostomy for gastric ulcer	1 to 3
" " " duodenal ulcer	1
" " " and cautery excision for gastric ulcer	2.5
Partial gastrectomy for gastric ulcer	7

Individual and specially expert surgeons may have lower mortalities.

B. Ultimate Results.

	Cures.
Gastro-jejunostomy and cautery excision for gastric ulcer	75 per cent.
" " " for duodenal ulcer	85 "
Partial gastrectomy for gastric ulcer	90 "

Some claim a higher percentage of cures, but, if the patients are watched for many years, recurrence of symptoms is more common than we anticipated.

¹ W. J. Mayo, *Surg. Gyn. and Obstet*, 1924, xxxix, 241; James Sherren, *Index of Prognosis*, 1922, p. 515; and Sir Berkeley Moynihan, *Abdominal Operations*, 1926.

CHAPTER VIII

HOURL-GLASS CONTRACTION OF THE STOMACH¹

For a long time hour glass contraction was thought to be nearly always congenital in origin but Moynihan has shown that it is almost invariably due to gastric ulcer. The ulcer which is generally placed at the lesser curvature and extends to the anterior and posterior surfaces of the stomach gradually contracts and draws the greater curvature upwards,

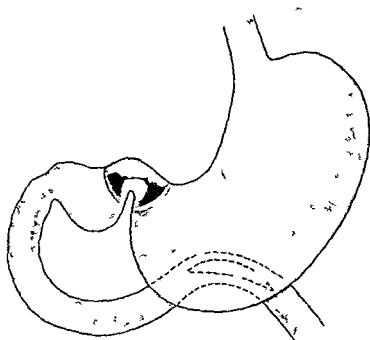


FIG 111 Posterior gastro jejunostomy after Mayo's method for hour glass contraction with patent pylorus

spasmodic contraction of the latter adds to the deformity and obstruction. Adhesions also form to the under surface of the liver to the anterior abdominal wall or towards the spine. These may drag upon and narrow the stomach. Less than 1 per cent of hour glass contractions are caused by carcinoma. Eusterman² has recorded three cases of syphilitic hour glass stomach. There is little doubt that spasm of muscle around an ulcer also plays an important part in narrowing the tubular orifice joining

¹ Most of this chapter is derived from my paper on this subject in the *British Medical Journal* March 25 1911 and from another conjointly with Dr A F Hurst in the *Guy's Hospital Reports* 1921 lxxi No 2 p 168

² *Collected Papers of the Mayo Clinic* 1914 vi 20

the two gastric pouches. There is a specimen in the museum at Guy's Hospital showing a moderate degree of hour-glass contraction due to gastrostomy, and a congenital gastric fistula has led to similar contraction of the stomach. The situation of the constriction varies a good deal. Usually the cardiac pouch is the larger. In a quarter of the cases pyloric or duodenal stenosis is associated with hour-glass contraction of the stomach; then the pyloric pouch is dilated and sometimes much larger than the cardiac. Sometimes the stomach is trilocular owing to the contraction of two ulcers.

Hour-glass contraction was found in 6 per cent. of the cases of chronic gastric ulcer coming to operation at the Mayo clinic. At least 85 per

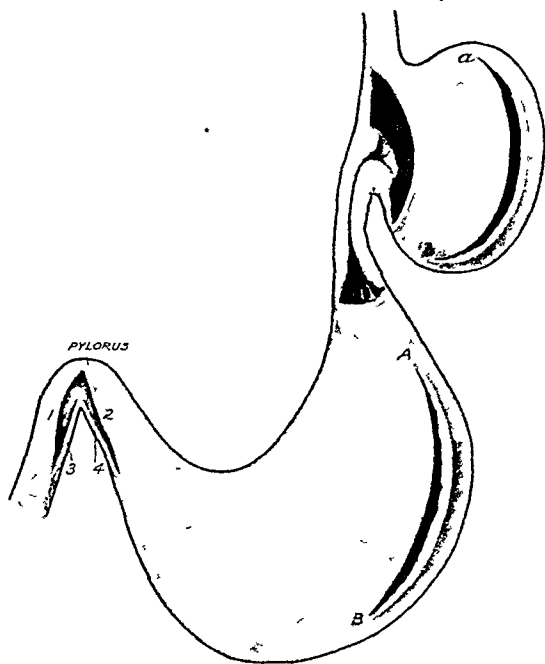


FIG. 112. Gastro-gastrostomy and Finney's operation for hour-glass contraction and pyloric obstruction. (See case on p. 188.)

cent. of hour-glass contractions occur in women in spite of the greater frequency of gastric ulcer in men.

Diagnosis. The condition would not have been recognised clinically in the majority of my cases without the aid of the bismuth and X-ray method of examination. No operation would have been performed in some of them, and the patients would have died unrelieved with their condition unrecognised. Twice a diagnosis of late carcinoma had been made, and a hopeless prognosis had been given.

Although in every case of organic hour-glass stomach the diagnosis can be made with far more ease and far more certainty with the X-rays than by any other method, a small number of cases have been reported, and a larger number remain unrecorded, in which the diagnosis made after an X-ray examination has not been confirmed at the subsequent

operation for hourly glass contraction may have a functional origin and be spasmodic sometimes associated with gastric or duodenal ulcer or as in one striking case which I saw, with chronic appendicitis. Repeated examinations prevent error. An ulcer upon the lesser curvature and adherent to the liver may so limit the mobility of the stomach as the patient stands as to produce an apparent hourly glass contraction. The constriction of the shadow disappears when the patient assumes the horizontal position.

Hourly glass contraction may be overlooked when the stricture is very tight unless the screen examinations are repeated several hours after the bismuth meal is taken (see Fig 117).

Treatment. Although medical treatment may greatly relieve the symptoms of hourly glass stomach in its early stages an operation should be performed as soon as the diagnosis has been made as it is rarely possible to cause the ulcer to heal completely and in the process of partial healing under medical treatment the inevitable contraction of the scar leads to increasing obstruction whilst in less favourable cases the ulcer may recur, spread or even become malignant. Occasionally after an ulcer has healed the patient remains quite comfortable so long as he is careful with his diet in spite of having a well marked hourly glass contraction of the stomach.

The patient should be carefully prepared for the operation the stomach is washed out if there is much stasis and after this the diet should be limited to sterile liquids for two days before the operation. Rectal salines may also be given with advantage in severe cases.

The operation should begin as a rapid exploration of the whole abdomen and any obvious source of infection—such as a diseased appendix—should be treated. The stomach pylorus and duodenum must be carefully examined, for without this precaution a cardiac pouch a trilobular stomach or associated pyloric or duodenal obstruction has been overlooked with disastrous consequences. In six cases mentioned by Veyrasset¹ the pyloric pouch alone was drained by a gastro jejunostomy with fatal results.

The exact nature of the operation must depend on the conditions found on exploration for the same operation is not suitable for all cases. Much depends on the size of the cardiac pouch the presence or absence of pyloric obstruction or adhesions and any suspicion of malignant disease. The condition of the patient has also to be taken into consideration for this is frequently too bad for a long and severe operation.

The immediate need is to overcome the obstruction so that the patient may be saved from starvation. Under these conditions excision which may appear the ideal radical operation may be far too dangerous and therefore, wrong. Experience has also shown that it is rarely necessary.

Hour-glass contraction depends chiefly on the formation of scar tissue in connection with a chronic ulcer. Recovery under medical treatment is prevented by the increasing obstruction with the consequent starvation and the forcing of food through the narrow neck of the hourly glass over the surface of the ulcer. When the obstruction is overcome by operation the food no longer passes over the ulcer, full diet can be taken with safety.

¹ A. Veyrasset *Rev de Chir* 1908 xxxvii: 761

and complete healing may be expected ; there is abundant evidence that this does, in fact, take place.

The surgery of simple and malignant hour-glass contraction will be considered separately.

(1) **Simple Hour-glass Contraction.** One or more of the following may be required :

- (1) Gastro-gastrostomy.
- (2) Gastro-jejunostomy, posterior or anterior, single or double.
- (3) Gastro-plasty.
- (4) Excision of the ulcer.
- (5) Excision of the stricture.
- (6) Partial gastrectomy.
- (7) Retrograde dilatation.
- (8) Jejunostomy.

The choice of operation depends chiefly on the presence or absence of pyloric obstruction in addition to hour-glass contraction. It follows that the discussion will be greatly facilitated by adopting this natural division.

(a) **Hour-glass Contraction without Pyloric Stenosis.** When there is no pyloric obstruction and the cardiac pouch is of a good size, posterior gastro-jejunostomy (Fig. 111), engaging the lower part of the cardiac pouch, is attractive, because it not only overcomes the mid-gastric stricture in a simple and safe way but it also permanently corrects the excessive secretion of acid, which is such an important cause of the persistence of the ulceration when a stricture has once formed. This hypersecretion, if unchecked, may not only delay the healing of the ulcer at the stricture but may contribute to the formation of a new ulcer in the proximal sac. This actually happened in one of my early cases, a gastric ulcer developing on the lesser curvature above the old stricture which had been overcome by gastro-gastrostomy. A secondary posterior gastro-jejunostomy completely relieved the symptoms, and the patient has remained well for eight years. When the cardiac pouch is small, posterior gastro-jejunostomy is not only difficult, but the unusual position of the stoma, especially as regards the jejunum, makes vicious vomiting likely to follow. In one of my cases this had to be corrected by entero-anastomosis a year later. Extensive adhesions on the posterior wall of the stomach or a very small inelastic cardiac pouch may make posterior gastro-jejunostomy difficult or impossible. In this case either gastro-gastrostomy (Fig. 112) or anterior gastro-jejunostomy, engaging the cardiac pouch, must be performed ; of the two the former is the better operation.

Gastro-gastrostomy is, as a rule, the most satisfactory operation, for, when well done, it effectively and permanently removes the obstruction without altering the physiological conditions of the stomach (Fig. 113), and without trespassing on the ulcerated stricture through which the food probably never passes again. Moreover, it is a very safe operation, and it carries no risk of gastro-jejunal or jejunal ulcer or of vicious vomiting, which is especially likely to follow gastro-jejunostomy performed under unusual difficulties. When the upper pouch is very small, gastro-gastrostomy may be difficult, but by making a curved incision a sufficiently large opening can be obtained. The vertical gastric incision figured in some of the books cannot be made nearly long enough to provide adequate drainage. This operation is much more easily done on the front of the

stomach for adhesions in the lesser sac, and the distortion of the stomach makes a posterior operation very difficult without any compensating advantages. In some cases a gastro jejunostomy in which the jejunum is joined to the lower border of both pouches has been added to the gastro gastrostomy with the object of gaining the advantages of both operations while avoiding some of their disadvantages.

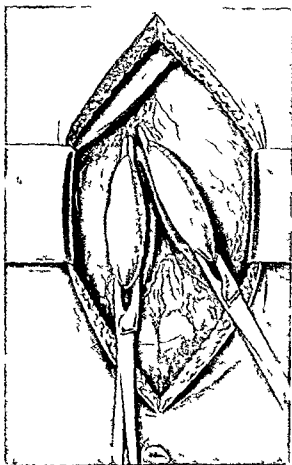
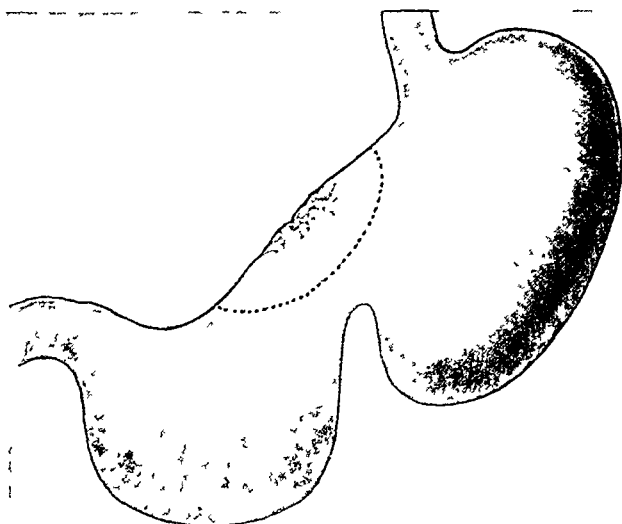


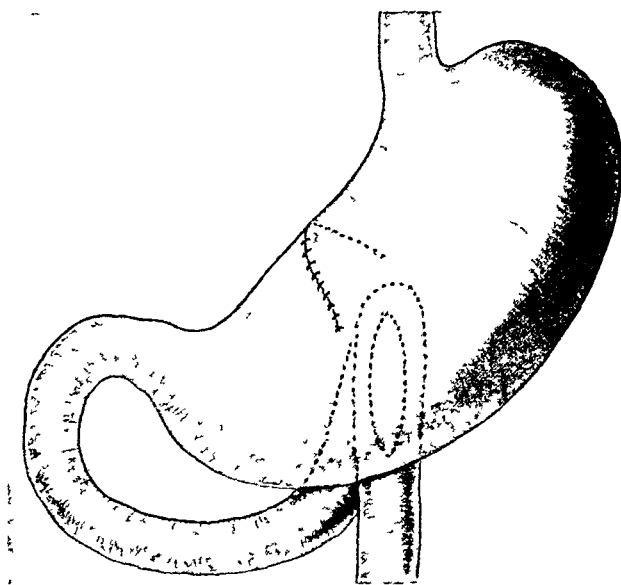
FIG 113 Gastro-gastrostomy. Clamps are applied to the cardiac and pyloric pouches and the subsequent steps are similar to those figured under gastro jejunostomy.

Operation—The essential points of gastro gastrostomy—the operation most needed for the relief of hour glass contraction of the stomach—now require attention. It is of vital importance to make the stoma as large as possible especially when this is the only operation performed. With this object very large pouches of the cardiac and pyloric parts of the stomach are so secured in strong curved clamps that a long curved incision can be made in them about one inch above and nearly parallel to the greater curvature. The points of the clamps are just below and in front of the stricture and their handles below on the greater curvature well to the right and left. The pouches are brought together and joined by two layers of No. 00 formalin catgut sutures as in gastro jejunostomy (Fig 113).

Gastro-plasty, as advocated by Kammerer (Fig. 115), is not nearly such a satisfactory operation, for by it the stricture and the ulcer, which is practically always present, are laid open; hæmorrhage is more likely to follow and the sewing is more difficult owing to the adhesions which



A



B

FIG. 114 The ulcer is excised at A, and the opening closed as in B Sometimes posterior gastro-jejunostomy is also done as in B

generally bind down the contracted part of the stomach. Inseparable adhesions to the liver or pancreas, especially if the ulcer is near the cardia, make gastro-plasty difficult and too dangerous, for some of the sewing has to be done very deeply in the epigastrium under cover of the left costal margin.

In some cases it is possible and advisable to excise the ulcer upon the lesser curvature (Fig 114) without approaching too near the greater curvature. When the V shaped opening thus made is closed the narrowing is abolished and the natural shape of the stomach is restored. This operation has the merit of immediately removing a chronic ulcer which is slow to heal and may be regarded as a possible source of malignant disease but it is unnecessarily difficult and severe for bad cases and is only to be undertaken at any time by surgeons of considerable skill and

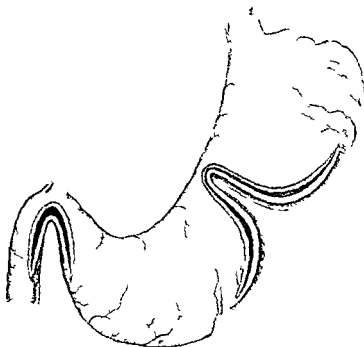


FIG 115 Gastro-plasty and Finney's operation for hour glass contraction at the pyloric obstruction

experience in gastric surgery. It must be remembered always that gastro-gastrostomy which is a comparatively easy operation cures these patients at a very small risk.

Removal of the part of the stomach bearing the stricture (Fig 116) has been very strongly recommended by some surgeons but it is usually unnecessarily severe for simple ulcers and it exposes a feeble patient to undue risk. For malignant hour glass contraction this operation is sometimes an excellent one.

Moynihan¹ records a remarkable case in which it was impossible to join the cardiac pouch to the pyloric pouch or jejunum owing to adhesions. He opened the pyloric pouch and dilated the stricture in a retrograde manner and to his surprise the patient made a good recovery.

Temporary jejunostomy has been performed in some cases when no other operation could be done with advantage (Eusterman)². The rest

¹ Sir Berkeley Moynihan *Lancet* 1904 i 413 *Abdominal Operations* 1918 i 984

² G B Eusterman *Mayo Clinics* 1914 v 20

afforded to the stomach for some months may improve the local conditions so much that a secondary radical gastric operation may become possible.

(b) **Hour-glass Contraction with Pyloric or Duodenal Stenosis.** When the pylorus is movable Finney's operation of gastro-duodenostomy (Figs. 112 and 115) appears to be the best method of overcoming the associated pyloric stenosis for it can be performed in far less time, when time is important in these enfeebled patients requiring two anastomoses, and particularly because it carries no risk of vicious circle or gastro-jejunal

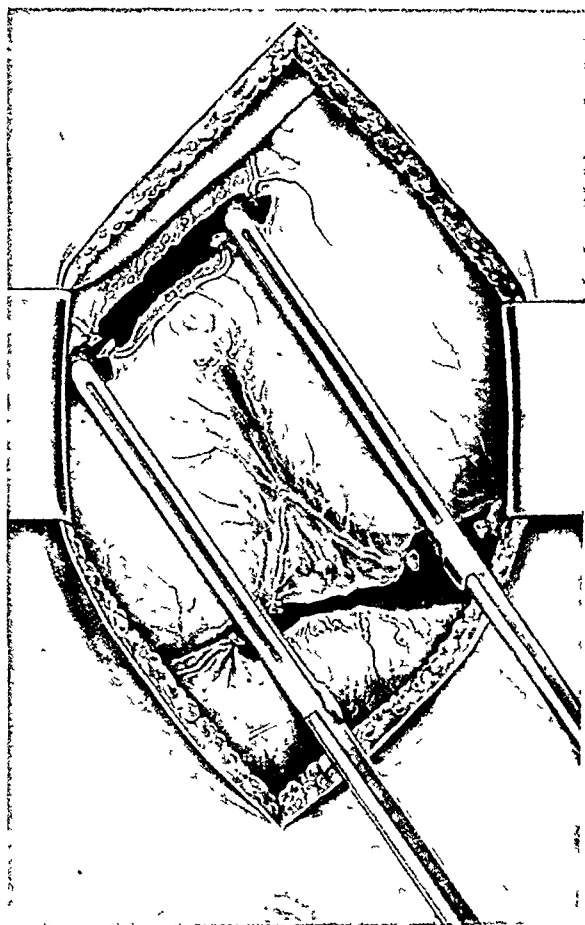


FIG. 116. Excision of the tubular ulcer, causing hour-glass contraction. The cardiac and pyloric pouches are then sewn together.

ulcer. It may be objected that Finney's operation does not drain the stomach as well as gastro-jejunostomy, but this depends largely on the size of the opening, which can be made very large by Finney's method. It is possible that gastro-jejunostomy, by allowing more bile and pancreatic juice to reach the stomach to neutralise the gastric juice, is a surer safeguard against recurrence of ulceration in the stomach. It is certainly considerably better and easier when there is active ulceration or extensive adhesion at the pylorus. When the pylorus is fixed or ulcerated, the

ideal operation seems to be a single posterior gastro-jejunostomy added to gastro gastrostomy, the jejunum being joined to the pyloric pouch.

Double posterior gastro-jejunostomy is not satisfactory under these circumstances for various reasons. It is difficult to drain the two pouches thoroughly through the limited space available in the mesocolon. Moreover, there are as a rule extensive and firm adhesions behind the stomach and the mesocolon may be considerably shortened and adherent. In some of my cases it seemed quite impossible to join the jejunum to the posterior surface of the very small cardiac pouch without undue risk of angulation and obstruction of the long drawn up loop of the jejunum around which the mesocolon, although sewn to the stomach, is very likely to contract.

Double anterior gastro-jejunostomy is an alternative I have never thought worth trying judging from the comparatively poor results of this operation for pyloric obstruction. It is well known that gastro jejunal ulcer and vicious circle are unduly common after it.

(2) *Malignant Hour glass Contraction*. It is not always easy to say whether hour glass contraction is innocent or malignant. There is plenty of evidence to show that carcinoma may supervene upon a simple ulcer of the stomach, and it is clear that the early stages of the malignant change are difficult or impossible to recognise at the operation. Cancer may be suspected if the ulcer base is unusually thick and hard and its edges hard and raised if the glands in the lesser curvature are hard and considerably enlarged or if any nodules are seen on the peritoneum covering the ulcer.

If there is a reasonable suspicion of cancer and the patient's condition is fairly good, partial gastrectomy should be performed, the duodenum closed and the jejunum joined to the open end of the cardiac pouch in front of the colon after the Polya Mayo method. When the growth is irremovable a gastro jejunostomy should if possible, be performed for this overcomes the obstruction and gives relief for some time. It is rarely practicable to perform the posterior operation, but an anterior anastomosis engaging the cardiac pouch high up and well to the left of the obstruction is satisfactory and well worth doing. It prolonged the life and relieved the obstructive symptoms of one of my patients for nearly two years and of another for six months. In a few instances a jejunostomy may be easier and safer.

Results of Operation. Mortality—Veyrasset's¹ statistics published in 1908 show a mortality of 16 per cent for two hundred and sixty operations for simple hour glass stomach, but six of the deaths were due to draining the pyloric instead of the cardiac pouch. The death rate has much diminished since then especially when great care is taken to select the operation, or combination of operations which is most suitable for each case. As a rule gastro gastrostomy is applicable and is attended by a very small risk considering the state of nutrition of these starved patients. One of us (R. P. R.) has operated on over fifty cases with only two deaths due to the operation. One patient died from accidental suffocation soon after the operation. It is fair to put the mortality at under 4 per cent.

Ultimate Results—These are very good when the obstruction is

¹ A Veyrasset *Rev de Chir* 1908 xxxviii, 761

thoroughly overcome. In the majority of my cases I have adopted gastro-gastrostomy and added Finney's operation, if necessary, to overcome duodenal stenosis. I have been able to trace nearly all my patients, though a few have changed their addresses during the War. They are invariably very pleased with the results of the operation, but a second operation had to be performed for recurrence of gastric symptoms on two occasions; once a new ulcer had formed higher up on the lesser curvature after gastro-gastrostomy; gastro-jejunostomy was performed, and the patient has remained well for twelve years. In the other cases a chronic vicious circle developed and was relieved by entero-enterostomy a year later. The posterior gastro-jejunostomy had engaged a small cardiac pouch, the stoma being too high and too far to the left, causing kinking of the jejunum.

The following remarkable case was published, with others, in the *British Medical Journal*, March 25, 1911:

Mrs. M. D., an American lady aged 42, was brought to me by Dr. J. C. Cook towards the end of October, 1909.

History. She gave a history of lifelong constipation and indigestion. About ten years ago she began to have attacks of biliary colic about once or twice a year, but these entirely ceased four years ago. She has never been jaundiced. Since she was a girl she has suffered a great deal from indigestion. For the last three years she has had almost constantly a dull pain in the epigastrium, but this has become a great deal worse within the last few months, and has lately shifted up the sternum as high as the sternal notch, where it is sometimes very severe, especially when the patient swallows. The indigestion has been very bad during the last eighteen months. At first she used to vomit about once or twice a week, but gradually this has increased in frequency to once every day, and lately after every meal containing any solid. She has never had hæmatemesis or noticed melæna. Gradually the amount that she can swallow at a time has diminished. After the food she has a feeling of a lump in the throat and under the breast bone. For months she has not been able to take solid food in comfort. The attempt has always been followed by great pain, which is only relieved by the return of all the food. One day she took an oyster divided into four pieces; this was followed by great pain and vomiting, which was only relieved when the last piece of oyster was returned four hours later. The only solid that she could occasionally take in comfort was a Welsh rarebit. Occasionally her mouth fills with water, and then she brings up a small amount of mucus. The act of swallowing itself is not painful if the patient is content with a small amount of liquid at a meal. For the last year she has not been able to take tea. For months she has lived on peptonised milk, Benger's food, Brand's essence, and so on, in decreasing quantities at a time. These have been supplemented by nutrient enemata and suppositories. She has wasted progressively for two years, but much more rapidly during the last six months. About two years ago her weight was 130 lb.; now she is only 56 lb., although she is 5 ft. 9 in. in height. During the last few months she has had several attacks of shivering, associated with exacerbation of vomiting. In spite of all this the patient has led an active life, often travelling two hundred miles a day in her motor-car and managing the business affairs of her daughter. She was taken to see a well-known consulting physician in May, 1909, who is said to have diagnosed malignant disease in the abdomen, possibly in the stomach or pancreas. He gave a bad prognosis and advised that the patient should be allowed to live and do as she liked.

Condition upon Examination. The patient was extremely thin and feeble. She was only able to walk into my consulting-room with difficulty. She was not able to dress or undress herself. Her skin was yellow, dry, and wrinkled. The temperature was 97°. The hands and feet were cold. There was some oedema of the ankles.

Alimentary System. All the natural teeth were missing, having been extracted about fifteen years ago and replaced by complete sets of artificial teeth. The tongue was raw and red. When asked to swallow a glass of milk she was only able to take half a tumblerful in small sips. Any attempt to take more gave rise to pain and a

feeling of distension at the lower end of the sternum. The abdomen was carinated and in spite of the fact that the abdominal wall was very thin no tumour could be felt anywhere in the abdomen. There was a little resistance in the gall bladder region but no dullness or tumour. A succussion splash could be obtained a little below the level of the umbilicus. A pelvic examination revealed no abnormality. The respiratory system was normal in spite of a history of possible phthisis at the lower part of the right upper lobe. The nervous system was normal except for great irritability of temper. In view of the difficulty of diagnosis between œsophageal stricture and hour glass contraction of the stomach with pyloric obstruction an X ray and bismuth examination of the stomach was advised. Three days later the patient was asked to swallow a tumblerful of milk containing 1 oz. of the oxychloride of bismuth. After much coaxing she was only able to swallow half this amount. She was then placed standing before the X ray apparatus. It was at once seen that the œsophagus was not distended so that the obstruction could not be in it. A small shadow was seen just below the diaphragm and from the right border of this a narrow streak of bismuth extended into a lower shadow giving the characteristic appearance of hour glass stomach with an unusually small cardiac pouch. As the patient swallowed more bismuth the lower shadow gradually increased until it was much larger than the upper one. It extended from two inches below the umbilicus to a little below the symphysis pubis. The fluid took a long time to run away from the upper sac so that the obstruction was evidently severe. The size of the pyloric pouch and the delay in the exit from the stomach made it clear that there must be pyloric obstruction as well. An operation was advised and the patient consented. The next day was spent in preparation. The patient was given nothing but sterilised milk and boiled water by the mouth and rectal salines were administered every four hours. This improved the pulse and the general condition of the patient to a great extent. The false teeth were taken away and the mouth thoroughly cleansed several times a day with an antiseptic mouth wash.

Operation. On the morning of the second day after the examination Dr. Page gave an anæsthetic and the abdomen was opened through an incision made as high as possible in the left rectus muscle some of the fibres of which were cut across in order to give more room. The stomach was explored and the conditions suggested by the X rays were discovered. The upper pouch was very small being about the size of a hen's egg. The lower pouch was fairly large being about the size of a normal stomach (Fig. 112). The pylorus was considerably narrowed but fairly movable. The scar of a healed ulcer was seen upon its anterior surface. The constriction in the stomach was very hard and tight. There was not enough thickening of the wall to suggest carcinoma nor were there any signs of any enlarged glands in the small or large omentum or pancreas. The stricture was 3 in. long and appeared to be due to the healing of a large saddle shaped ulcer occupying the lesser curvature quite close to the œsophagus and extending far downwards upon both the anterior and posterior walls of the stomach. The lower part of the stomach was pulled downwards and to the right so as to bring the cardiac pouch into view. For reasons that will be presently discussed a gastro-gastrostomy was decided upon. It was found to be impossible to control the cardiac pouch with clamps without passing one blade through the gastro-colic omentum into the lesser sac of the peritoneum and upwards behind the stomach towards the œsophagus. The other blade was placed in front of the stomach and the lesser omentum and the forceps were locked and closed. Another long clamp was applied on the anterior wall of the pyloric pouch near the greater curvature and with its points directed upwards and to the left. The clamped portions of the stomach were then carefully isolated with moist packs and they were joined together by two layers of direct sutures just as in gastro-jejunostomy. Linen thread was the suture material used. The opening in the cardiac pouch extended from the lower and right border upwards and to the left of and above the œsophageal orifice. This was the only way to make it long enough. The wall was extremely thick and hard. The mucous membrane was inflamed and closely adherent to the other coats so that none of it could be removed separately. Therefore an ellipse of the whole thickness of the fibrous wall was removed. It was impossible for the through and through suture to pick up the mucous membrane all the way round without unduly narrowing the anastomotic opening but the other coats were so extremely fibroid that there did not appear to be any danger of the stitches cutting out. The external sero-muscular suture having been completed tags of the lesser and gastro-colic omenta were fixed over

the suture line. The pylorus was then brought into the wound, and an incision was made along its supple lower border and prolonged into the lower borders of the duodenum and stomach, which were close together. The wound was closed after Finney's method of gastro-duodenostomy, but with continued instead of interrupted sutures. Before the opening was made, clamps were applied to prevent leakage and hæmorrhage. The gall-bladder was found to be full of stones, but it was neither inflamed nor adherent, and the cystic duct was patent. There was no indication for removing the stones, especially as any prolongation of the operation would

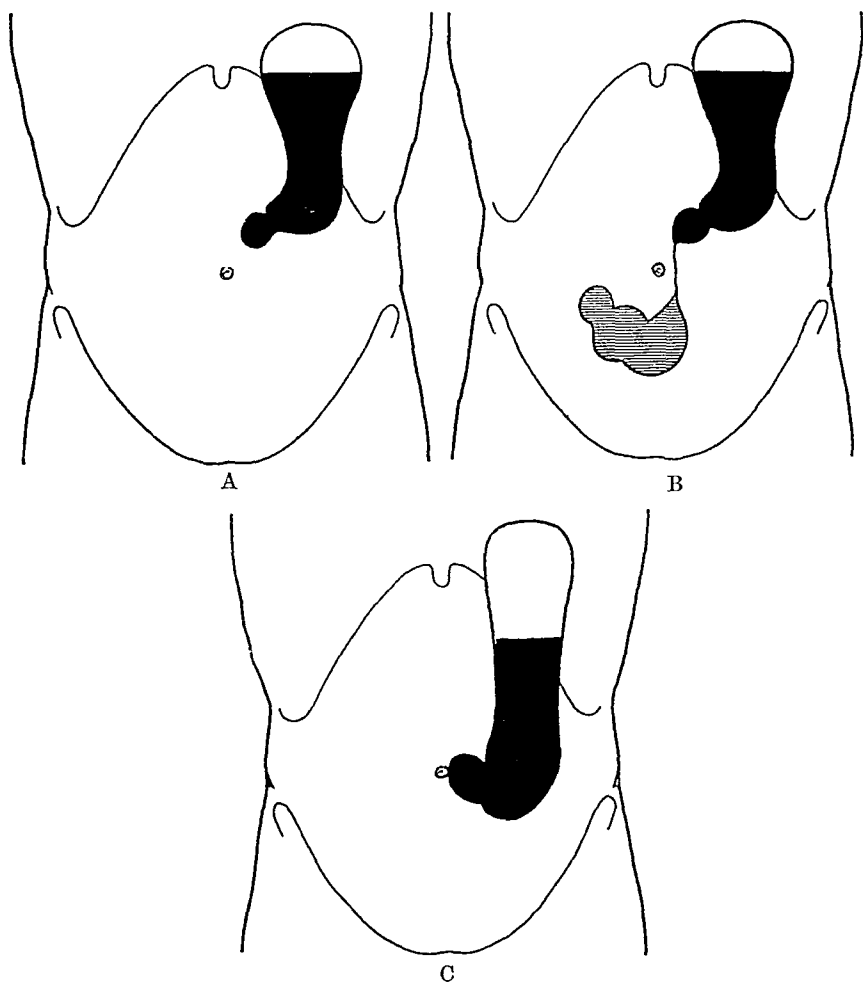


FIG. 117. Hour-glass contraction upon radiography with bismuth. A was taken an hour after a bismuth meal. B was taken six hours after the meal, when the lower sac became evident for the first time. C, Three weeks after gastro-gastrostomy. (From *G. H. Reports*, 1921, lxxi, 178.)

probably have resulted fatally. Moreover, the gall-stones had given rise to no symptoms for four years. When the operation was completed the stomach seemed to be about the normal size and shape. The new pylorus was very wide. The gastro-gastrostomy had drawn the pyloric pouch upwards and to the left. The abdomen was closed in layers, the operation being completed in forty-five minutes. A saline enema was given immediately on the return of the patient to bed. The patient was rather collapsed for the first two days. She was given water to drink from the first, and saline and nutrient enemata were administered alternately every four hours. The mouth was exceedingly dry, and thirst was very severe. Towards the end of the second day milk was given by the mouth, and from that time onwards

nutrients were discontinued. The food given by the mouth was gradually increased, so that at the end of fifteen days she was on minced full diet. Gradually the patient became able to swallow larger amounts at a time. She left the home after five weeks with her condition very much improved, having gained over a stone in weight. By September, 1910, she had gained 3 st 10 lb. In 1912 she weighed 9 st, having more than doubled her weight. I removed gall stones impacted in the common bile-duct and cystic ducts in February, 1913, and the patient made a rapid recovery. She was quite well when last heard of in 1920.

CHAPTER IX

OPERATIONS FOR PYLORIC STENOSIS, CONGENITAL AND ACQUIRED. RAMMSTEDT'S OPERATION. FINNEY'S OPERATION. GASTRO-DUODENOSTOMY. DUODENAL ILEUS.

HYPERTROPHIC PYLORIC STENOSIS

CONGENITAL hypertrophic stenosis of the pyloric sphincter chiefly affects healthy male infants, less than one-sixth being females. About half of those affected are first-born children. The symptoms of obstruction generally develop between the second and the fourth week after birth.

Rammstedt's Operation. This operation, which consists of simple division of the enlarged pyloric sphincter, is by far the best for congenital hypertrophic pyloric stenosis. Rammstedt discovered it accidentally, while trying to perform Weber's extramucous modification of simple pyloroplasty.¹ The parts were so rigid and friable that the stitches designed to close the longitudinal wound in a transverse manner would not hold. The patient was so ill that the attempt had to be abandoned, with the wound through the serous and muscular coats left open. The patient recovered, and Rammstedt had the wit to see the significance of this unexpected recovery, and that it was not necessary to close the incision in the muscle and peritoneum. It is, however, necessary to make sure that the mucous membrane is not perforated and that bleeding is arrested.

Rammstedt, having tried the operation with success in other cases, established it on a firm basis, and other surgeons in Europe and America adopted it with equal success. John Thomson,² in a valuable paper based upon an experience of 100 consecutive cases of this disease (including thirty-nine operations) during twenty-five years, strongly advocated Rammstedt's operation; four out of his five cases (80 per cent.) recovered, whereas only seven out of his eighteen cases (38·9 per cent.) of Loreta's operation recovered, and only three out of twelve (25 per cent.) were saved by gastro-enterostomy. R. A. Ramsay,³ in his excellent articles based on personal experience of ten cases treated by Rammstedt's operation, with five deaths, strongly recommends the operation and advocates its earlier adoption.

Indications for Operation. Minor degrees of this condition certainly recover completely under careful medical treatment, but when, in spite of it, typical projectile vomiting, wasting, palpable tumour and visible

¹ *Med. Klin.*, 1912, viii, 1702; and *Cent. f. Chir.*, 1913, xl, 3.

² *Edin. Med. Journ.*, January, 1921, 1.

³ *Brit. Journ. Surg.*, 1921, viii, 397; and *Trans. Med. Soc. Lond.*, 1919, xlii, 125.

peristalsis continue, an operation should be undertaken without delay, for malnutrition greatly prejudices the result. J F Poynton¹ regards a palpable pyloric tumour as by far the most reliable aid to diagnosis, indeed, he believes it to be the only absolute diagnostic sign. Undue delay is the chief cause of death after Rammstedt's operation, as is well

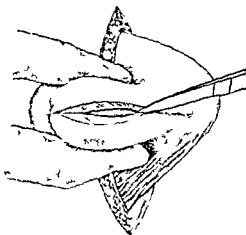


FIG 118 Rammstedt's operation. The pyloric sphincter is divided completely without opening the mucosa.

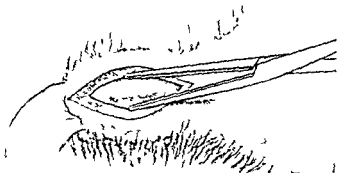


FIG 119 Rammstedt's operation. The sphincter is separated and the mucosa allowed to protrude.

shown in hospital cases which usually come too late. T Twistington Higgins² found the mortality to be 63.6 per cent when the duration of symptoms was over 50 days and only 6.4 per cent when operation was undertaken within twenty-five days. When the hypertrophied pylorus can be seen or felt, or when radiographic examination shows marked delay there is little hope of recovery without operation. Radiographic examination is rarely required and may be harmful.

¹ *Lancet* 1924, 215

² *Ibid*

Preparation. The condition of the infant is improved as much as possible by gastric lavage, careful feeding, warmth and the administration, by the rectum or subcutaneously, of saline solutions containing glucose and bicarbonate of soda. In bad cases the stomach is washed out two hours before the operation.

Operation. Chloroform and ether are too dangerous because they may cause acidosis in these starved infants. Gas and oxygen is the best and safest anæsthetic, but this is not administered until the surgeon and his assistants are actually ready to start the operation. A right paramedian incision 2 inches long is made in the epigastrium displacing the rectus outwards. The lower margin of the liver is drawn upwards and the thickened pylorus is found, brought out and examined. It is held by the left hand, while a longitudinal incision is made and gradually deepened upon its anterior surface, in the bloodless area between its vascular upper and lower borders. This incision is commenced near the duodenal end of the thickening, and all cutting is made from right to left (never towards the duodenum), so that the anterior fold of duodenal mucous membrane close to the pylorus may not be opened—a mistake which is easily made. Very slowly *all the circular muscle fibres* are divided and separated by blunt dissection with blunt-pointed scissors, until the dense mucous membrane bulges well between the retracting ends of the wide sphincter. It is not necessary to close the gap in the serous and muscular coats, although Strauss¹ recommends using a muscular flap for this purpose. Bleeding is stopped by hot, moist gauze pads or by under-running and tying with fine catgut, for intra-peritoneal hæmorrhage has caused death in some cases (Figs. 118 and 119).

By gently squeezing the stomach the patency of the pylorus and the absence of perforation of the mucosa can be proved. Any perforation is closed with fine catgut, turning in the edges. The pylorus is then replaced and the parietal wound is rapidly and securely closed.

The greatest care is taken in the after-treatment, especially in feeding and keeping the child warm after the operation. Breast feeding should be adopted whenever practicable, but, failing this, every care should be taken to sterilise the food and thus prevent diarrhoea and fever, which are the most important causes of death after operation.

Prognosis. Before the adoption of Rammstedt's operation the mortality of this disease was very high, especially in hospital practice, owing to delay, gastric dilatation and malnutrition before operation, and infective diarrhoea with hyperpyrexia after operation. Between 1909 and 1917 thirty cases were treated medically at the East London Hospital,² and all died except one. At Great Ormond Street, from 1914 to 1918, there was a mortality of 80 per cent. in fifty-four cases, and none of the late cases submitted to operation recovered. The mortality after Rammstedt's operation is rapidly decreasing and will continue to do so owing to earlier diagnosis and operation. Thomson had a mortality of 20 per cent. in five cases, Downes³ 17 per cent. in 175 cases, Tyrrell Gray⁴ 14 per cent. in seventeen cases, and Strauss reports 107 cases with a mortality under 3 per cent.

¹ *Surg. Clinics of Chicago*, February, 1920, p. 93.

² R. Warren, *Lancet*, 1920, i, 1359.

³ Downes, *Journ. Amer. Med. Assoc.*, 1920, lxxv, 228.

⁴ H. Tyrrell Gray and G. R. Pirie, *Lancet*, 1919, ii, 515.

Loreta's Operation Divulsion or Rupture of the Pyloric Sphincter
 Loreta¹ many years ago made a small opening into the stomach near the pylorus and introduced his finger to dilate fibrous structure of the pylorus in an adult. The immediate results of the operation were fairly successful but perforation occurred in some cases and in others the stricture recurred so that the operation fell into disuse. Later F F Burghard and others adapted it to congenital hypertrophic pyloric stenosis with considerable success. G F Still² in his valuable contribution states. In the last eight years Mr Burghard has performed this operation on 46 of his private cases with only one death. The hypertrophied pylorus

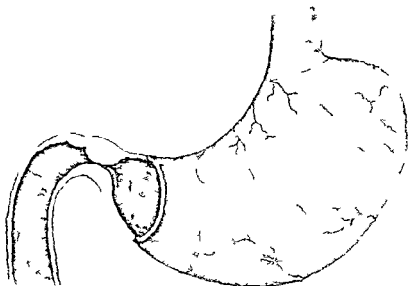


FIG 190 Pyloric obstruction

is brought out and steadied by the left hand while through a small incision in the anterior wall of the stomach conical metal dilators (in gradually increasing sizes) are very carefully passed through the pylorus. The hypertrophied sphincter usually with its peritoneal covering gives way rather suddenly at last but the redundant and freely movable lining of mucous membrane remains entire and bulges into the gap thus allowing the immediate and free passage of food into the intestine. A tube is passed through the stomach into the duodenum and a suitable meal is given. The wound in the stomach is closed with two continuous sutures of fine catgut.

This operation can be performed more quickly and with less shock than any other operation except that of Rammstedt. Of these two the latter is undoubtedly the better operation being speedier more controllable and attended by less shock the clean cut being less harmful than forcible rupture of the sphincter.

¹ *La D'culsione d'g tale del Ploco etc* "edited in F at Treves Bologna 1884

² *Brit Med Journ* 1903: 531

Pyloroplasty as originally introduced by Heinecke and Mikulicz has been very properly abandoned for more radical methods. An incision two inches long was carried along the anterior wall of the stomach through the stenosed pylorus into the duodenum, and this incision was sewn in the reverse direction so that the suture line became transverse to the axis of the bowel, which was thus considerably enlarged. For a time some relief usually followed, but recurrence of ulceration and stenosis frequently ensued, and secondary gastro-jejunostomy had to be performed.

Finney's Operation¹ (Modified). Dr. Finney described his ingenious operation as a new method of pyloroplasty, but it is also a form of gastro-



FIG. 121. Finney's operation. The incision is near the contiguous borders of the stomach and duodenum, a quarter of an inch in front of the great omentum.

duodenostomy. The abdomen is opened through the upper part of the right rectus. The pylorus, the pyloric end of the stomach and the first part of the duodenum are thoroughly freed from adhesions, so that the subsequent steps may be made easy and all tension prevented. Finney lays stress on the need of separating the adhesions very thoroughly, and considers this to be one of the most essential points of the operation.

The duodenum is mobilised after Kocher's method so that the parts employed in the anastomosis can be brought out of the wound. Sometimes a rubber cushion or Lilienthal bridge under the loin is of considerable assistance. Clamps with their points directed upwards are applied to folds of the contiguous surfaces of the stomach and duodenum. As the incision to be presently made extends along the lower border of the pylorus, the clamps cannot include the whole of the parts engaged in the anasto-

¹ *Bull. Johns Hopkins Hosp.*, July, 1902, and *Surg., Gynec. and Obstet.*, 1914, xviii, 273, where there are excellent figures. Finney used no clamps to control hæmorrhage or prevent leakage, but relied on holding up the parts with stay sutures. He used interrupted mattress silk sutures in front.

mosis In spite of this they serve to prevent leakage and to bring the parts well into the wound. Packs are carefully placed the posterior part of the sero muscular suture is inserted and a quarter of an inch in front of this a long curved incision is made. The incision divides the stricture near its lower border and extends for two and a half inches into the stomach and duodenum (see Fig 121). To limit subsequent contraction as much of the scar as possible is excised from either side of the incision especially if the walls of the pylorus are much thickened. To

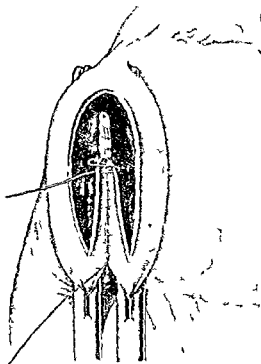


FIG. 122 Finney's operation. The two continuous sutures are shown.

prevent the formation of obstructing valves and to make suturing easier, redundant edges of mucous membrane are removed. Any hæmorrhage at the upper end of the wound is arrested and the posterior edges of the incision are joined together by means of a continuous catgut suture which pierces all the coats of the stomach and intestines and commences above (see Fig 122). This is continued in front after Connell's method. The sero muscular suture is then completed in front. Continuous sutures are better than interrupted for they make the operation easier speedier and safer (see Fig 123).

The advantages claimed for this operation are—that it is easy and simple and can be performed in a very short time. There are distinct advantages when pyloric stenosis coexists with hour glass contraction.

and has to be treated after gastro-gastrostomy in a feeble patient. Also that the size and position of the new orifice are such as to provide free drainage of the stomach, unless the latter is greatly dilated; that the development of a vicious circle or jejunal ulceration is impossible; there is a peculiar freedom from post-operative nausea and vomiting (although regurgitation of bile does occur in some cases). One of us, however, reported a case, which he believes to be unique, in which a valve below the stoma obstructed the duodenum, calling for secondary gastro-jejuno-stomy, which proved successful. Even a large ulcer may be removed from the anterior aspect of the pylorus, stomach or duodenum without

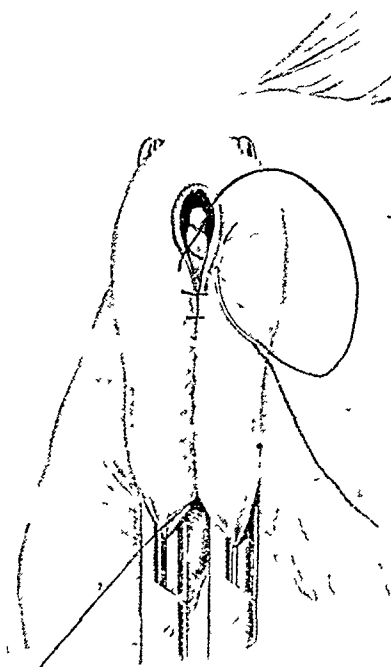


FIG. 123. Finney's operation. The deep suture is nearly completed after Connell's method. This is supported by continuing the Lembert suture upwards in front.

fear of subsequent cicatricial contraction. It does not interfere with digestion in the duodenum and with the reflex secretion of bile and pancreatic juice; hence absorption should be a little better than after short-circuiting. It is particularly suitable for the cases of partial pyloric stenosis described by Maylard.

Disadvantages. Although the operation is a great improvement on pyloroplasty, the separation of adhesions is troublesome and may be dangerous. It is contra-indicated in most cases of active ulceration, with dense adhesions.

It may be concluded that Finney's operation is not so generally applicable as gastro-jejuno-stomy, but that it is occasionally the operation of choice for uncomplicated fibrous stenosis.

Gastro-duodenostomy. This operation was designed by Jaboulay with the object of overcoming pyloric stenosis and yet to allow the food to

enter the duodenum for digestive purposes and particularly with the view of preventing the development of regurgitant vomiting. Theoretically gastro duodenostomy is on these two accounts better than gastro jejunostomy but as a matter of fact some bile regurgitation may follow gastro-duodenostomy.

There is no risk of jejunal ulcer following gastro duodenostomy and even a duodenal one is extremely unlikely to develop for the acid chyme now enters quite near the biliary papilla and is soon neutralised by the bile and pancreatic juice but when the stomach is considerably or greatly dilated gastro jejunostomy is undoubtedly to be preferred and this operation is both simpler and safer in the great majority of cases. As compared with pyloroplasty gastro duodenostomy has the advantage of avoiding diseased tissues.

Although Kocher had previously joined the open end of the duodenum to the posterior surface of the stomach after resection of the pylorus Jaboulay was the first to suggest gastro duodenostomy as a lateral anastomosis. He joined the duodenum to the anterior surface of the stomach by making a vertical incision in each and folding the duodenum over and to the left. This is only possible with a very movable duodenum or after making it mobile by Kocher's method. Prof Kocher gives the following description of his method¹.

The delicate layer of the parietal peritoneum covering the kidney is divided vertically one and a half inches external to the second part of the duodenum and the incision is then continued vertically downwards through the upper layer of the transverse mesocolon (which is held on the stretch) as far as the larger branches of the vessels. The fingers are then introduced behind the left edge of the incision through the peritoneum and the duodenum is separated from the vertebral column the vena cava and the aorta until it can be brought forward.

Clamps are applied to folds of the anterior walls of the stomach and duodenum and an anastomosis is effected as described under gastro jejunostomy. Packs are carefully placed to isolate the parts.

The method is subject to only one contra indication viz the presence of such extensive adhesions to the under surface of the liver that the duodenum cannot be sufficiently freed. This difficulty of adhesion can however often be overcome as we have proved in three of our cases, but the fact of having to perform the suturing inside the abdomen is apt to interfere with the security of stitching especially in difficult cases. It is on this account that sub pyloric gastro-duodenostomy did not meet with universal acceptance. The sub pyloric portion of the duodenum cannot be drawn out of the wound on account of its connection with the gastro hepatic omentum and the important structures contained within it. This fixation to the under surface of the liver may be so firm that only the lower two thirds or only the lower part of the vertical portion of the duodenum together with the inferior flexure can be brought in contact with the stomach.

We therefore propose that instead of Villard's sub pyloric gastro duodenostomy the name 'lateral gastro duodenostomy' be given to this operation to distinguish it from our method of inserting the divided duodenum into the posterior wall of the stomach after resection of the pylorus.

¹ *Operative Surgery*

The great difference between Villard's sub-pyloric gastro-duodenostomy and our procedure is that we render the descending portion of the duodenum, the inferior flexure, and a considerable portion of the third (transverse) part so movable that the parts to be sutured can readily be raised up and surrounded with gauze, so that the sutures can be introduced extra-peritoneally with comfort and security."

One of us (R. P. R.) has performed this operation on selected cases for the last ten years, and has found its immediate and ultimate results satisfactory, serious vomiting and secondary ulceration being very rare after it (see Figs. 108 and 109, pp. 176 and 177).

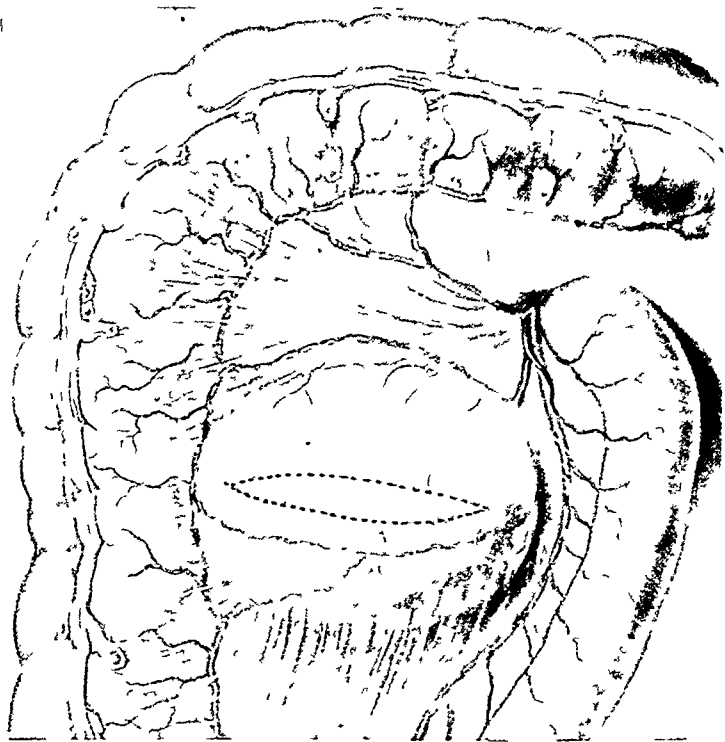


FIG 124 Duodeno jejunostomy. The dilated third part of the duodenum is exposed through a transverse incision in the posterior parietal peritoneum

Duodeno-jejunostomy. Acute or chronic duodenal ileus or dilatation of the duodenum may result from pressure upon the third part of the duodenum as it crosses the spine behind the root of the mesentery by the superior mesenteric or right colic vessels. This pressure may result from congenital abnormality of the parts, congenital or acquired prolapse with over-filling of the right colon or small intestine or from inflammation, often tuberculous, of the lymphatic glands at the root of the mesentery. As a result the duodenum above the obstruction dilates, the pylorus may become patent and the stomach dilated. Ulceration of the duodenum or stomach may ensue, and it is possible that infection of the biliary and pancreatic ducts may follow, as pointed out by Wilkie.¹ Chronic, incom-

¹ *Brit Journ Surg*, 1921, ix, 213.

plete or intermittent obstruction may culminate in complete or acute obstruction at any time especially when the patient is lying supine in bed and constipated after operation particularly those upon the stomach or biliary apparatus. Acute dilatation of the stomach and 'vicious

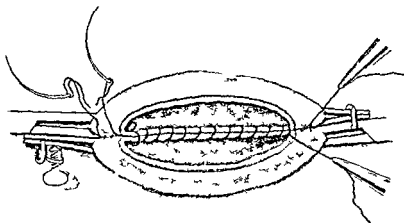


FIG 1st Duodeno jejunostomy The usual method of inserting two continuous sutures of fine catgut

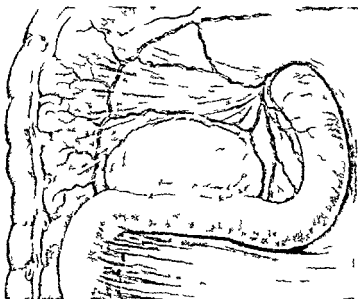


FIG 1st Duodeno jejunostomy The jejunum has been joined to the third part of the duodenum and the upper edge of the posterior or peritoneal wound is sewn to the jejunum

circle are also sometimes due to this cause an illness or operation having upset a precarious balance. Radiographic examination may reveal dilatation with delay in the duodenum and reverse peristalsis is sometimes demonstrated but this is not always conclusive evidence of duodenal

ileus. Apart from a definite attack of obstruction, however, no abnormality may be demonstrated on the radiographic screen.

The subjects of this disease are often thin women, afflicted with visceroptosis. They suffer for years from attacks of vomiting, often thought to be hysterical. Upon exploration the duodenum is found to be dilated and, more especially, the third part bulges forwards below the transverse meso-colon on the right side. In doubtful cases D. P. D. Wilkie demonstrates this dilatation by inflating the stomach and duodenum through a stomach tube.

In cases of supposed acute dilatation of the stomach or of "vicious circle," if lavage combined with elevation of the pelvis and the semi-prone position fail, prompt exploration of the abdomen is indicated, for delay means death. If the third part of the duodenum bulges below the meso-colon, duodeno-jejunostomy is indicated. The same operation is applicable for true "vicious circle," and is often easier than the usual form of entero-anastomosis near the stomach. A word of warning is necessary here. It is wise to explore very thoroughly and consider critically before deciding that a moderate degree of dilatation of the duodenum is the cause of symptoms, for there is some danger of adopting the operation for unsuitable cases, with disappointing results.

During all abdominal operations, especially if the exploration has failed to establish the diagnosis, the surgeon should remember the possibility of duodenal ileus and carefully examine the duodenum above and below the transverse mesocolon. He should also remember that it may be the exciting cause of existing gastric or duodenal ulceration. In such a case, where a large adherent gastric ulcer and duodenal ileus coexisted, the writer successfully performed partial gastrectomy by the Polya-Balfour method.

Operation. The operation of duodeno-jejunostomy, which was first suggested by Barker in 1906, was first performed by Stavelly in 1908 and is a comparatively safe operation. In acute cases it is sometimes necessary to wash out the stomach before giving the anæsthetic, but there is no need to do this in chronic cases. The abdomen having been opened and the transverse colon raised, displaying the dilated third part of the duodenum, the peritoneum covering this is incised in a bloodless area and generally in a transverse direction. The third part of the duodenum is mobilised, brought forwards and secured in curved clamps. A similar pouch of the jejunum, about seven inches from its origin, is also clamped, and lateral anastomosis performed with continuous sutures of fine catgut in the usual manner. The cut edge of peritoneum, just above the anastomosis, is stitched to the jejunum with two catgut sutures.

Results. When performed on suitable cases only, the results of this operation are very gratifying. E. L. and W. A. Kellogg¹ collected 58 cases, including 41 of their own, with no death and 31 cures. Wilkie² reported 21 cases without a death and with good immediate results. It is very desirable to follow these cases for a long time so that we can ascertain if the improvement is lasting.

¹ *Ann. of Surg.*, 1921, lxxiii, 578.

² *Brit. Med. Journ.*, 1922, ii, 1222.

CHAPTER X

CANCER OF THE STOMACH INNOCENT TUMOURS OF THE STOMACH

PARTIAL GASTRECTOMY

In this operation a large but variable part of the stomach is removed. For carcinoma of the pylorus an inch of the duodenum and a large part of the stomach are usually removed so that the channel can be re-established only by gastro jejunostomy engaging the cardiac remainder but after resection of early and small cancers it is occasionally possible to make an end-to-end union of the stomach to the duodenum after Billroth's first method. Midgastric carcinomata of moderate size are best treated by sleeve resection. For simple chronic ulceration of the pyloric end of the stomach a smaller portion usually needs removal so that it is sometimes possible to re-establish the channel by end-to-end union. When more of the stomach has to be removed for penetrating chronic ulcer of the lesser curvature well away from the pylorus either sleeve resection or partial gastrectomy with lateral anastomosis of the jejunum to the end of the cardiac remainder has to be performed. With a great reduction in its mortality the operation is more and more frequently performed both for malignant and innocent ulcerations. For carcinoma although it may not always eradicate the disease it offers both a greater prolongation of life and greater relief than gastro jejunostomy without unduly increasing the immediate risk. It is often difficult to be sure that a chronic gastric ulcer is innocent and for this reason either resection or excision of the ulcer should be performed whenever practicable without greatly adding to the risk. Moreover a callous ulcer may become malignant in spite of gastro jejunostomy.

Indications (i) Malignant disease of the stomach especially of the pyloric segment. This is nearly always carcinomatous but sarcoma is *not so uncommon as it is generally supposed to be*.

(ii) Some cases of chronic ulceration of the pyloric region especially when malignant disease is feared.

(iii) Some cases of hour glass contraction with ulceration at the stricture and especially with associated pyloric or duodenal stenosis or ulceration. When the pyloric pouch is of good size and the pylorus and duodenum are normal the pyloric and cardiac remainders may be joined end to end.

(iv) Some cases of jejunal or marginal ulcer complicating gastro jejunostomy.

(v) Some cases of duodenal ileus complicated by gastric or duodenal ulcer.

(i) **Malignant Disease** This is the most important indication for resection and it calls for special attention here. It is significant and

fortunate that in the large majority of cases carcinoma, like simple ulcer of the stomach, starts at or near the pylorus upon the lesser curvature. Significant because of the undoubted risk of a chronic ulcer becoming malignant. Fortunate because a growth in this situation—

- (a) Soon leads to obstructive signs of great value in diagnosis.
- (b) The growth is often palpable in the epigastrium, and
- (c) Is favourably placed for resection if the diagnosis is made in time.

In a few cases carcinoma commences at the cardia or in the fundus, where radical operation is rarely practicable. Growths upon the anterior or posterior walls near the middle of the stomach are more amenable, if they are discovered in time, but this is unusual, for they do not cause obstruction or early symptoms.

Without operation cancer of the stomach is absolutely hopeless. Spontaneous cure is not known, and medicine and light treatment are of no use except to alleviate the symptoms of inoperable disease. Surely surgery can do better than this if given a chance, but too often the surgeon is not asked to see the patient until the diagnosis is obvious and the prognosis hopeless. Over 8,000 persons¹ died from cancer of the stomach in England and Wales in 1921, a thousand more than in 1919. Only a small proportion of these consulted a surgeon. This is due to ignorance, apathy and pessimism on the part of the public, and waste of time on the part of the medical attendant.

Diagnosis. Much time is wasted on laborious attempts to arrive at a diagnosis from various laboratory tests. This "scientific and deadly delay" (Mayo) often throws away the opportunity of radical and successful operation. The laboratory tests must be regarded as nothing more than aids in the diagnosis. For instance, free HCl, although usually diminished, may be found even in excess with early gastric carcinoma. It may be greatly reduced in pernicious anæmia, chronic pancreatitis or cholecystitis. Apart from obstruction, X-ray examinations are not of great value in early cases. Later, delay and defective filling are most suggestive signs, and so is the radiographic demonstration of an ulcer with a diameter of over 2·5 cm. as pointed out by MacCarty.² Cancer of the stomach in its early stages does not give rise to symptoms which can be said to be characteristic of the disease. Rapid and progressive wasting, anæmia, pain, anorexia, nausea and vomiting are suggestive. These, and especially a palpable tumour or obstructive signs, however, indicate an early exploration. Some half-cooked rice and a few raisins are given with some soup in the evening. If on washing out the stomach in the morning any food remnants are found there is clearly obstruction and, although this may be due to a simple ulcer, it strongly indicates an operation both for diagnosis and treatment. *It cannot be too strongly urged that diagnosis to be early enough must frequently be made by exploration.* Operation is delayed because the immediate mortality is generally, but wrongly, supposed to be very high, and the *prospect of permanent cure or prolonged relief is believed to be poor.*

As regards the **mortality**, the technique of partial gastrectomy has been so much improved in recent years that it ought not to be above

¹ Registrar-General's Report, 1921.

² *Collected Papers of the Mayo Clinic*, 1922, xiv, 96.

10 per cent, and the ultimate results are improving—at least 25 per cent being alive and well five years after the operation¹

As it is, less than a third of the few cases of carcinoma of the stomach, coming to the surgeon, are diagnosed early enough to allow a radical operation. *Without exploration, how are we to tell if a case is inoperable?* This is not possible in some cases but the following clinical signs indicate that the growth is inoperable, and that it is inadvisable to submit the patient to an exploration —

(i) The discovery of dropped and grafted nodules of growth in the pelvis on rectal or vaginal examination

(ii) Enlarged supra clavicular glands, especially common on the left side

(iii) Nodules of growth at the umbilicus or under the skin of the abdomen

(iv) Ascites, indicating peritoneal growth or obstruction of the portal vein

(v) Nodular enlargement of the liver

(vi) The size and position of the growth as felt clinically and estimated by X ray examination are of great value in deciding whether resection or short circuit can be hopefully undertaken

In the great majority of cases an exploration should be undertaken before any tumour can be felt, but it is certainly not true that resection may be considered to be impracticable because a tumour is evident for even the induration around a simple pyloric ulcer may be felt in thin patients. It must not be concluded from the apparent mobility of a growth felt through the abdominal wall that a resection is practicable, or vice versa

Moreover, the patient may be too exhausted to stand the operation. Careful medical treatment by lavage, rest, dieting and transfusion may allow a preliminary short circuit to be carried out, followed later by resection

Upon exploration the following points indicate that the growth is unsuitable for resection —

(i) *Secondary Growths in the Viscera*, especially in the liver. The hand is always passed above as well as below both lobes of the liver, for it is not uncommon to find isolated nodules of growth upon the diaphragmatic surface of the liver. A direct local invasion of the anterior edge of the liver is not always a contra indication, for a wedge shaped piece may be resected with the primary growth. More often, an invaded gall bladder or even a part of the transverse colon may be removed. Invasion of the pancreas has been usually regarded as a strong contra indication, but portions of the pancreas may be safely removed

(ii) *Peritoneal Infection*. The hand is passed into the pelvis, and the small intestine is inspected. If nodules of growth are discovered it is generally useless to attempt resection of the primary growth, but an isolated nodule in the pelvis need not necessarily interfere, for it may be either removable or of slow growth, so that prolonged relief may be expected from resection

(iii) *The Size, Site and Degree of Fixation of the Growth*. While in many cases cancer of the pylorus may remain long limited to the pylorus

¹ C H Mayo, *Ann of Surg*, 1919, lxx, 240

itself, it is very liable to infect the omenta and the lymphatic glands in the omenta and around the head of the pancreas, and later to cause secondary growths in the liver and other parts.¹ Adhesions, too, are very frequently met with between the stomach and the colon, pancreas and liver.

When adhesions are present the immediate mortality of the operation is greatly increased, and this is especially true of adhesions involving the pancreas. The prospects of permanent relief are, of course, much diminished, for the growth follows closely in the wake of inflammatory adhesions. *The more the growth has extended towards the cardiac orifice along the lesser curvature, the less the chance of successful resection.*

Moderate enlargement of the lymphatic glands is not a contra-indication to resection, for the glands are very frequently found to be merely inflammatory, and they may be seen near a simple ulcer. When the glands are of large size, hard, adherent or widespread, it is generally too late to attempt the removal of the growth.

From a careful consideration of the symptoms and the results of radiographic and chemical examinations, the diagnosis should be made more frequently before the growth becomes irremovable; and with this object an early exploration should be undertaken when the symptoms do not yield to treatment and suggest the probability of the existence of carcinoma of the stomach. The danger of an early exploration is very small, although a simple exploration in the late and inoperable cases carries with it a considerable risk, as shown by the experience of Kronlein and Milkulicz, who had a mortality of about 9 per cent. in such late explorations.

The researches of Cuneo, MacCarty, Borrmann, Jamieson, Dobson,² and others have taught us much about the ways in which carcinoma of the stomach spreads. This information is of great value in telling us when and how to attempt resection. It is fortunate that—

(a) *Dissemination into the Liver and other Viscera* is a late event.

(b) *Lymphatic Infection.* Cuneo pointed out that lymphatic infection occurs early in cancer of the stomach, and that it has occurred in over 87 per cent. of specimens removed by operation, therefore a great deal depends upon the lymphatic drainage of the stomach and of the cancer-bearing area, which in 80 per cent. of the cases is to the right of a line continued downwards from the right border of the œsophagus (*see* Fig. 127). The lymphatics drain into the glands in the gastro-hepatic and gastro-colic omenta. A few from the fundus pass into glands near the lower border of the splenic pedicle. The glands in the lesser omentum are fairly numerous, and consist chiefly of three groups, two of which are above the lesser curve of the stomach along the coronary and pyloric arteries, and another to the right of the cardiac orifice. Those in the gastro-colic omentum are all to the right of the line already mentioned, and they are especially numerous just below the pylorus. Here the lymphatic current is chiefly towards the right and soon carries the infection to the group of glands lying near the head of the pancreas to the right of the

¹ McArdle (*Dublin Journ. Med. Sci.*, lxxxiii, 511), having collected from the statistics of different writers 1342 cases, states that the pylorus alone was involved in 802, or over half the cases.

² *Lancet*, 1907, i, 1061.

coeliac axis. There is very little tendency for the disease to spread along the greater curvature towards the left into the fundus which can be safely left in pyloric and prepyloric growths which form the large majority of gastric cancers. Along the lesser curvature there is a great tendency for the disease to spread to the left both in the lymphatics in the stomach wall and in the extramural lymphatics. In some cases the primary lymphatic glands escape while the secondary ones are invaded. Occasionally there is an erratic spread so that the glands in the transverse mesocolon may be invaded early. It is very important to remove by gauze dissection all the lymphatic glands near the coronary pyloric

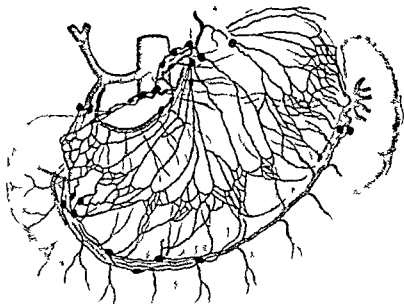


FIG. 197. The lymphatic drainage and blood supply of the stomach. Nearly all the glands are along the lesser curvature and above, below and behind the pyloric port on.

hepatic gastro-duodenal right gastric-epiploic arteries and coeliac axis thus eradicating most of the primary and secondary lymphatic glands. Infected glands vary much in size and without microscopic examination it is impossible to be sure whether a gland is or is not invaded. The only safe way is to remove all the draining lymphatic glands. In view of the occasional infection of the great omentum it is also wise to remove it as well as the lesser omentum. The degree of lymphatic infection varies very much and does not seem to have any very distinct relation to the position or size of the primary growth. Both the immediate risk and the ultimate prognosis depend very much upon the degree of lymphatic infection.

(c) *Local Spread* The disease spreads by permeation of the lymphatics of the stomach especially those in the submucosa and along the lesser curvature towards the cardiac orifice. Therefore most of the lesser curvature should be removed. Elsewhere cancer cells are very rarely found in the wall of the stomach more than 3 cm. from the

margin of the palpable and visible tumour or ulcer.¹ This is an important fact indicating that very wide resections of the stomach are not necessary as long as the lymphatics and lymphatic glands are extensively removed. The growth often seems to end abruptly at the pylorus, but microscopic examination has shown that permeation extends a little beyond this into the duodenum, so that it is always wise to remove at least an inch of the duodenum.

(d) *Peritoneal Infection.* Nodules of growth are commonly found in the peritoneum, especially at the bottom of the pelvis, and later upon

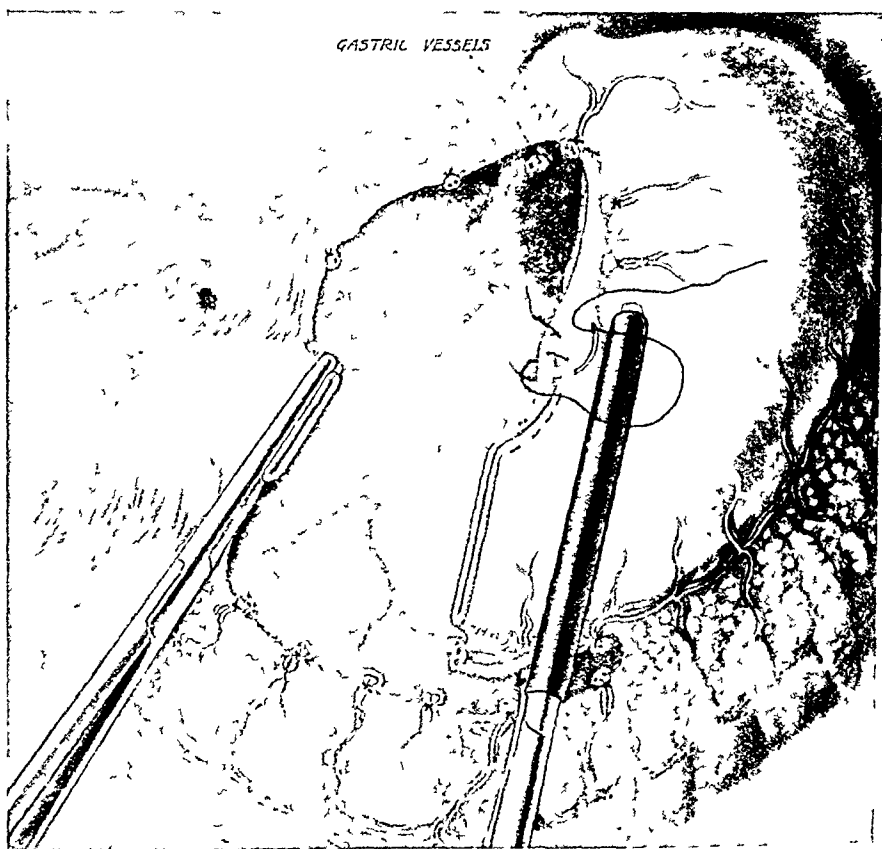


FIG. 128 Partial gastrectomy with end to end union (after Schoemaker and W. J. Mayo) The pylorus and most of the lesser curvature have been removed

the peritoneal covering of the small intestines. This is due to the direct infection by cancer-cells which have escaped into the peritoneal cavity and gravitated towards the pelvis. This infection is likely to take place when the primary growth has invaded and penetrated the peritoneal coat of the stomach, presenting a rough or raw appearance.

Therefore it is clear that resection to be ultimately successful must be wider than hitherto as regards the lymphatic vessels and glands. The immediate mortality of a well-planned resection even in fairly late cases is not much greater than that of gastro-jejunostomy, whereas the amount of relief and extension of life obtained is very much greater. The average

¹ W. J. Mayo, *Collected Papers of the Mayo Clinic*, 1924, xiv, 91.

relief after gastro-jejunostomy for growth is only about four months, and this relief is often incomplete owing to the presence of the ulcerating and decomposing growth

The more frequent excision of callous gastric ulcers will do much to prevent the development of cancer of the stomach, and many a developed but unsuspected cancer will be removed at an early and hopeful stage. The ideal is to operate at an early stage before the growth has become adherent to vital parts, and before the lymphatic glands have become

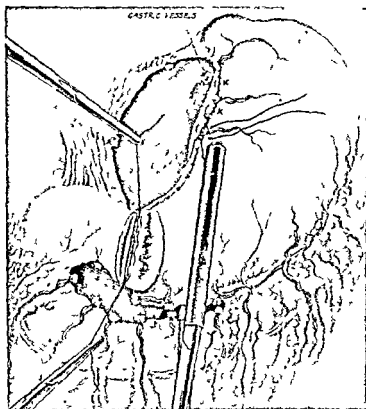


FIG. 129 Partial gastrectomy with end to end union (after W. J. Mayo). The posterior sero-muscular suture is shown.

invaded. Both the immediate and ultimate results of the operation will rapidly improve as this ideal is approached.

Choice of Operation This depends upon the site and extent of the growth. In many cases it is necessary to remove the pylorus, an inch of the duodenum, and the greater part of the stomach. After such extensive resections direct union of the stomach and duodenum, after Billroth's first method, is impracticable without undue tension. Therefore the duodenum is closed and the side of the jejunum is anastomosed directly to the cardiac remainder after Polya's method. It is better to place the loop of jejunum in front of the transverse colon after Balfour's method,¹ for if recurrence takes place, as it often does about the pancreas and transverse mesocolon obstruction of the anastomosis is not so likely when this method is used.

¹ C. H. Mayo, *Ann. of Surg.*, 1919, lxx, 237.

When the primary growth is small, Billroth's first method may be applicable, especially if it is carried out after W. J. Mayo's plan.¹ Mayo ties and divides the gastric vessels early, mobilises the lesser curvature, and removes the whole of the gastro-hepatic omentum with its contained glands and a considerable part of the lesser curvature of the

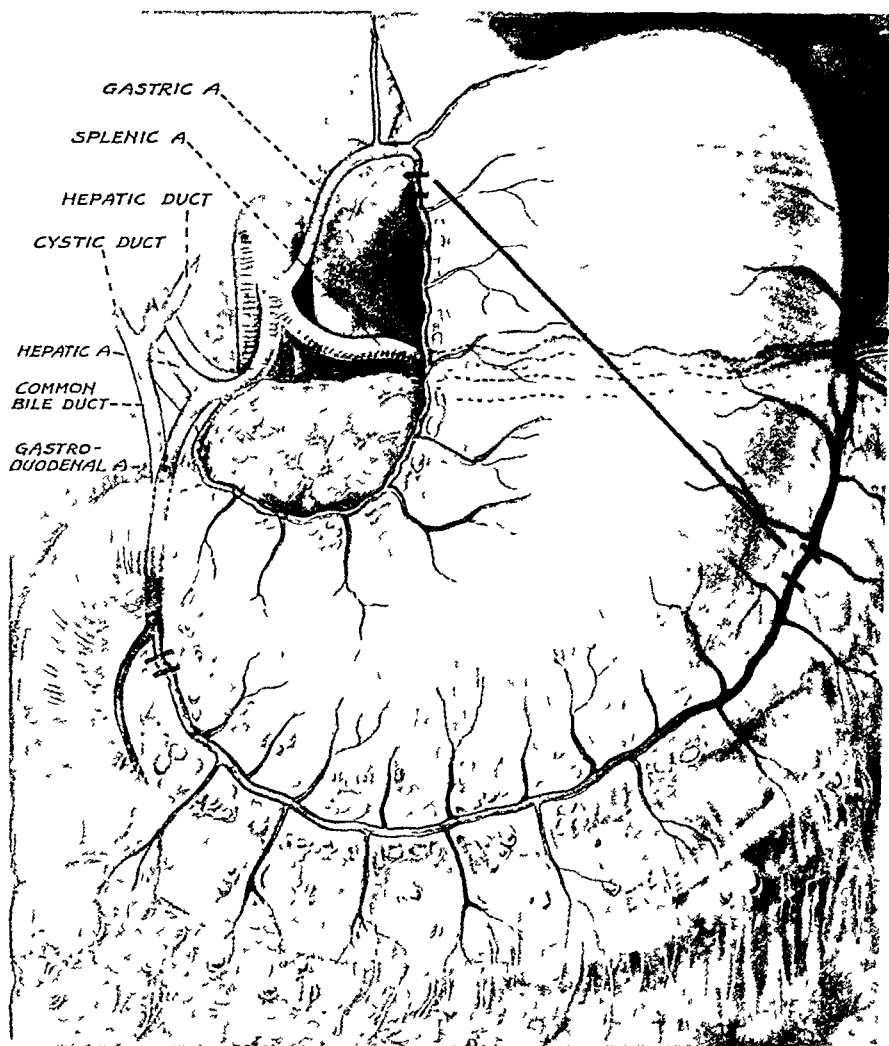


FIG. 130 The arteries of the stomach. Preliminary ligation of the gastric, pyloric, the right and left gastro epiploic vessels is of the greatest importance in gastrectomy.

stomach, along which the growth so often spreads. The wound in the stomach is sutured along the lesser curvature, so that the diameter of the opening left is not appreciably larger than that of the duodenum. With modern methods of suture the danger of leakage at the "angle" is negligible (Fig. 129).

When the growth is in the mid-gastric area and is not too extensive, sleeve resection, with wide removal of the lymphatic glands, is indicated,

¹ *Collected Papers of Mayo Clinic*, 1922, LV, 84.

and both the immediate and ultimate results of this operation compare favourably with those of other forms of resection¹ This is described under gastric ulcer

Operation in Two Stages In some feeble and old patients and especially in those suffering from severe pyloric obstruction with vomiting

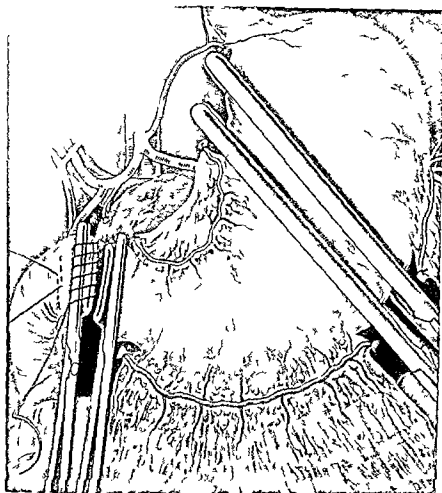


FIG 131 Partial gastrectomy Clamps applied and the duodenum divided The duodenal stump is sewn over the blades of the clamp holding it As the clamp is withdrawn the suture is tied A purse string suture is also shown

and rapid wasting it is sometimes necessary and wise to perform the operation in two stages and in these circumstances a preliminary gastrojejunostomy well to the left of the growth is indicated The improvement that follows this operation is often so marked that it is difficult to persuade the patient that another operation is necessary and it is therefore well to explain the plan of procedure before the first operation In some cases one or more blood transfusions are strongly indicated

¹ F S Judd and J H Lyons *Collected Papers of the Mayo Clinic* 1900 xiv 69

before the second part of the operation is undertaken. Secondary resection of the growth is sometimes made somewhat more difficult by the previous gastro-jejunostomy which limits the mobility of the stomach and sometimes makes it difficult to divide the latter far enough away from the growth. When this has been removed the openings in the

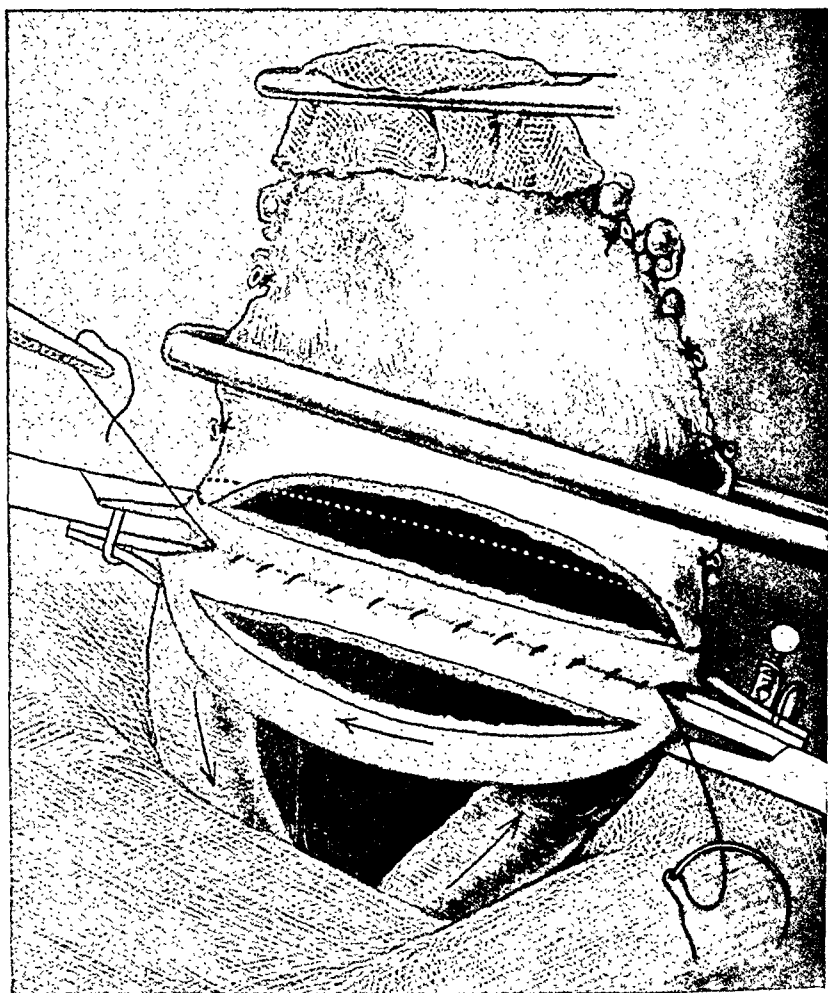
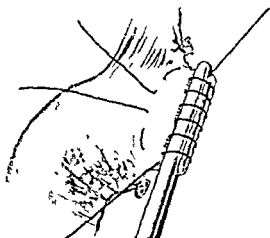


FIG. 132. Partial gastrectomy. The stomach is used as a tractor—the section having to be made high up; the serous suture has been inserted and only the posterior wall of the stomach divided. The deep suture is inserted before the section of the anterior wall of the stomach is completed. The direction of the current in the jejunum is shown.

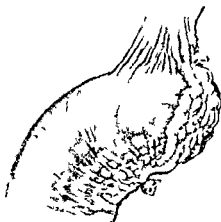
duodenum and stomach are closed, and the anatomy of the parts is like that of Billroth's second method, which is rarely performed as a primary operation nowadays because it is unnecessarily complicated and prolonged as compared with the Polya-Balfour method.

Operation. The operation which the writer nearly always uses for cancer is an extensive one after the Polya-Balfour method as modified by Moynihan, believing in giving the growth a wide berth. A free incision is made near the middle line extending from the right epigastric angle

downwards a little below the umbilicus. When the growth or ulcer is well to the left, it is an advantage to place the incision to the left of the middle line and sometimes parallel to and below the left costal margin. A thorough exploration is rapidly carried out to determine if resection should be undertaken. Sometimes an opening is made in the lesser omentum or gastro-colic ligament and a finger introduced into the lesser sac to examine the posterior surface of the growth and find if the latter



A



B

FIG. 133 Duodenum closed by a continuous Connell purse-string suture and omental flaps

has invaded the pancreas or transverse mesocolon. Large moist gauze pads are used to protect the parietal wound and also to fill the space from which the stomach is lifted forwards as far as possible. This pack holds the stomach forwards and makes the operation easier, as pointed out by Moynihan. The pyloric and left gastro-epiploic vessels are divided between ligatures, and the upper border of the duodenum

and the lower border of the stomach are cleared for half an inch at these points (*see* Fig. 131). The first part of the duodenum is separated from the pancreas by passing a forefinger behind it: it is then divided between two clamps placed at least one inch to the right of the pylorus. The distal end is closed with one piercing, continuous suture and buried with two purse-strings of fine catgut. The gastric end is protected

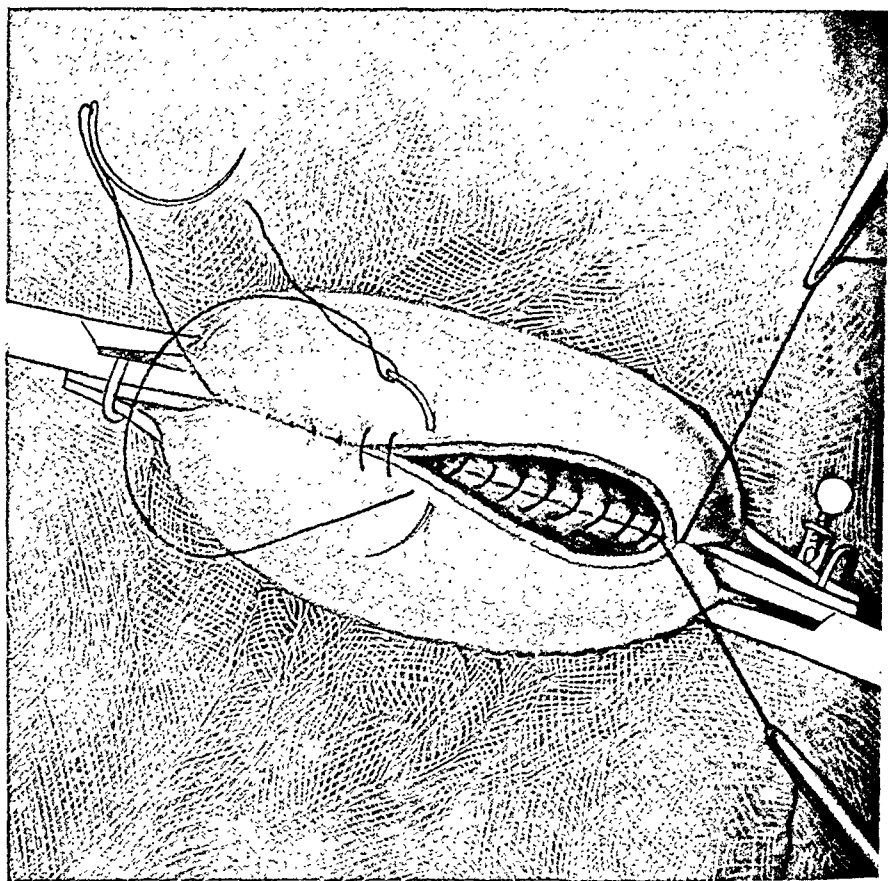


FIG. 134. Partial gastrectomy. The deep suture is nearly completed.

by a pad tied over it. As it is turned over the gastro-duodenal trunk or the right gastro-epiploic artery is tied, and the glands lying on the head of the pancreas and gastro-duodenal artery are separated from the pancreas by gauze dissection, which must be gentle to avoid hæmorrhage from the large veins at this spot. The gastro-colic omentum is tied piecemeal close to the transverse colon, and the stomach is completely separated from the pancreas, care being taken not to injure the middle colic vessels. If necessary some of the adherent pancreatic tissue can be shaved off with the knife and removed with the growth. Packs are now carefully placed behind and around the stomach, which is brought well forwards and turned over to the left to display the trunk of the gastric or coronary artery. This is firmly tied with strong catgut and divided close

to its origin in the celiac axis and above the upper group of coronary lymphatic glands which are to be removed with the stomach. Division of the coronary vessels liberates the stomach and allows us to deliver the greater part of it. A long rubber-covered clamp is now placed from below upwards upon the stomach well to the left of the proposed line of



FIG. 13.—Partial gastrectomy with antecolic approximation of a short jejunal loop.

section. The duodeno-jejunal flexure is identified and a loop of the jejunum which can be comfortably joined to the cardiac remainder of the stomach (in front of the colon) is carefully selected. The distance from the duodeno-jejunal flexure varies in different cases and may be anything from 4 to 8 inches; there must be no tension upon the loop or its mesentery for this may lead to obstruction either of the transverse colon or of the jejunum. The proximal part of the loop is joined to the greater curvature and the distal part to the lesser curvature of the stomach. The chosen loop is clamped and joined with a continuous sero-muscular suture of fine catgut to the posterior wall of the stomach $\frac{1}{2}$ inch to the left of the proposed line of section. The part of the stomach to be removed is

clamped just to the right of the line of section, care being taken to empty the part between the two gastric clamps (Fig. 132 to 135).

The stomach is divided and the growth removed ; an incision a little



FIG. 136. Partial gastrectomy with use of long jejunal loop and entero-anastomosis (after D. C. Balfour).

smaller than the gastric one is made in the jejunum, any excess of mucosa is removed, and the anastomosis is completed with a continuous through and through suture of No. 1 chromic catgut. The sero-muscular suture is completed in front, the great omentum turned up over the anastomosis and the abdomen is closed in layers with or without drainage at the lower angle of the wound. If the pancreas has been wounded or

there is troublesome oozing, it is wise to use a temporary drain of folded rubber sheeting

D C Balfour¹ uses a long jejunal loop and joins the proximal part of this to the lesser curvature of the stomach. To prevent retention of bile and pancreatic juice in the proximal limb he makes an entero anastomosis between the limbs of the loop believing this to be an important step, unattended by any disadvantages at least in cancer cases (Fig 136)

Illustrative Cases

CASE 1—Mrs E aged 41 a patient of Dr Brackenbury. She had suffered increasingly from indigestion for three years. Recently she had hæmatemesis and had wasted rapidly. She often vomited large quantities. Radiography revealed pyloric obstruction. I had felt a tumour of moderate size in the epigastrium a little to the right of the middle line. The patient looked ill and anæmic, was vomiting large quantities about once a day and was unable to take more than liquids. I therefore advised operation.

Operation on August 21st 1915 (Dr Brackenbury present).—A long incision was made in the epigastrium to the right of the middle line. A dilated stomach hypertrophied and oedematous was found and a pyloric ulcer of large size extending half way along the lesser curvature from the pylorus around which it formed a ring which was hard and felt like carcinoma. As the stomach was particularly movable and there were no growths in the liver pelvic peritoneum or glands I decided to resect the diseased part, and this was done without delay. The gastric artery was doubly ligatured and divided, the left gastro epiploic also, then the great omentum close to the transverse colon and the right gastro epiploic and pyloric arteries. The duodenum was crushed one inch beyond the pylorus and sealed with a running suture of linen thread and then invaginated by two purse-strings of the same material. A loop of jejunum was brought up through the transverse mesocolon and sewn to the back wall of the stomach along a selected line a little on the cardiac side of the middle of the stomach. Thick black thread was used. The stomach was divided near the line already mentioned between two clamps so that no leakage occurred. An opening the same size as the one in the stomach was made in the jejunum and an anastomosis made as in gastro jejunostomy black thread being used throughout. The sewing of the jejunum to the stomach before the growth was removed greatly facilitated the operation for the growth was useful as a tractor, and later on the attachment to the jejunum prevented retraction of the stomach during the insertion of deep sutures. The opening in the jejunum began four inches from the end of the duodenum, and by starting it here there was no tension upon the first part of the jejunum and duodenum. Only two layers of sutures were used for anastomosis. The great omentum was not removed but drawn up over the anastomosis and the stump of the duodenum. The opening in the transverse mesocolon was closed by two interrupted sutures. The operation lasted forty five minutes and the patient was not shocked after it. She was infused during the operation two pints being run into the arms.

She was very well the next day, but vomited once or twice. On August 23rd she frequently vomited small quantities of offensive green material and, as half a pint of sodium bicarbonate solution was given without affording any great relief, the stomach was washed out at 5 p.m. A very large quantity of bilious liquid was with drawn and the patient felt much better. She was up on the tenth day and walking about on the thirteenth and eating almost full diet. She rapidly gained weight and did very well. When last heard of, in December, 1924 (ten years later) she was still in excellent health. The growth was a typical carcinoma.

CASE 2—J W, aged 51. Gastric symptoms for four months vomiting anorexia, indigestion, constipation chronic hæmatemesis and melæna very severe anæmia and wasting lost twenty two pounds in fifteen days.

Operation, November 1909. The writer performed extensive but not complete gastrectomy, draining glands and omenta removed, duodenum closed, gastro-jejunosomy. Microscopical section shows carcinoma.

¹ *Collected Papers of the Mayo Clinic, 1924, xvi 79*

Patient did very well and returned to his ordinary work as a lift conductor. He gained over three stone in weight. At first he could only take small meals; very small remainder of stomach dilated considerably, as shown by the X-rays. He died of recurrence five years after the operation.

TOTAL GASTRECTOMY

It is very rarely necessary to remove the whole stomach, for when malignant disease is so extensive as to invade the whole stomach it is usually incurable for other reasons, such as extensive adhesions or secondary growths. Nor is complete gastrectomy desirable, for it is sooner or later followed by a fatal anæmia, possibly as a result of the loss of internal secretions from the stomach, or perhaps owing to the lack of hydrochloric acid, a condition which is an important etiological factor in Addison's or pernicious anæmia, as pointed out by A. F. Hurst. The technical difficulties are so great as compared with those of sub-total gastrectomy that it is desirable whenever possible to save even a small healthy portion of the cardia. The chief indication for the operation is that variety of chronic diffuse carcinoma of the stomach which produces a small leather-bottle stomach, the "linitis plastica" of Brinton. Fortunately secondary growths (and extensive glandular infection) are rarely associated with this condition. It is possible that the operation may be required for an inflammatory leather-bottle stomach.

It is unfortunate that a sharp distinction is not being drawn between complete and nearly complete removal of the stomach, and even when a small portion is left the operation should be called partial gastrectomy.

Conner, of Cincinnati, was the first to perform this heroic operation in 1883, but his courage was not rewarded, for the patient died upon the table.

Schlatter, of Zurich, was the first to perform the operation successfully, in 1897.

Paterson¹ "collected twenty-seven cases of total gastrectomy for malignant disease. Of the twenty-seven patients ten died and seventeen recovered, a result surprisingly good considering the extent and severity of the operation." He ascertained the subsequent history of all except two of the seventeen patients who survived the operation. Five of the patients had died, but the average survival was nineteen months. "Dr. Brookes Brigham's patient was in perfect health eight years after the operation. Dr. Macdonald's patient was alive and at work as a farm labourer, although seven years had gone by since his operation."

Six of the patients were living and well six years after the operation, and three were well five years after it.

As regards the method of operating, the best plan is the one adopted and so well described by Sir Berkeley Moynihan.² His patient was a man, aged 43, with malignant leather-bottle stomach. I venture to quote his description of the operation.

"*Operation.*—The abdomen was opened in the middle line by an incision which at first was about three inches in length, sufficient to allow of exploration, but which was increased subsequently to a length of eight inches. At the outset there was a very serious difficulty in exposing the

¹ Hunterian Lectures, 1906.

² *Lancet*, 1907, ii, 1748.

stomach. The patient was a man who had been stout, but who had lost weight rapidly; the anterior abdominal wall therefore shelved downwards from the elevated costal margin in such a manner as to make the upper part of the stomach appear to be at great depth from the surface. The patient, moreover, was not at all comfortable under the anæsthetic, and I had to wait a long time after opening the abdomen before I could proceed with the operation.

"When the stomach was exposed it was seen to be small in size with



FIG. 137. Complete gastrectomy. The stomach is used as a tractor to bring the œsophagus down for suture to the jejunum. The œsophagus is gradually divided, and a few turns of the deep suture are added after each snick with the scissors.

walls of great thickness and solidity. The whole organ, indeed, felt solid, resembling a very large uterus, having thick walls and an insignificant cavity within it. (This is well shown in the skiagraph subsequently taken.) The surface was smooth, white and opaque; there were no adhesions and but few obviously enlarged glands along the curvatures. Towards the cardiac end the stomach was larger than elsewhere, so that the organ had something of the shape of a Florence flask; the larger part, however, was still very much smaller than the normal. This being

the condition of the stomach, it was at once evident that the performance of gastro-enterostomy was impossible, for there was not sufficient cavity in the stomach to admit of any anastomosis being made. The alternative procedures were complete gastrectomy and either jejunostomy or duodenostomy; after some deliberation I decided in favour of the former and I proceeded at once to remove the whole stomach. It was at this point that the abdominal incision was enlarged. Hot moist swabs in two layers were then packed into the abdomen in the usual manner to isolate the field of operation. The stomach was now depressed as far as possible by forcible traction by an assistant and two long clips were applied to the coronary artery at its origin from the celiac axis. The artery was divided between the clips, and its proximal end was ligatured. The upper and lower coronary groups of glands were detached downwards towards the stomach by gauze stripping, and the cardiac end of the stomach was denuded by the same means. The gastro-hepatic omentum was divided after ligature as close up to the liver as possible until the upper border of the pylorus was reached. Here, by gauze stripping, the pyloric artery and the gastro-duodenal artery were exposed as they separately arose from the main hepatic trunk. The pyloric artery was ligatured and divided, and the finger was then passed downwards behind the pylorus and made to present at the lower border of the duodenum, where an opening was made in the great omentum. Through this opening the blade of a clamp was passed upwards behind the duodenum to present above the pylorus. When the clamp was closed it lay about one inch beyond the pylorus, and on the stomach side of it there lay the subpyloric group of glands. A second clamp with rubber-covered blades was now applied distal to it, and the duodenum was cut between them. A single strong catgut suture was then passed through the proximal part of the duodenum and round the clamp to prevent the clamp from slipping away. The distal end of the duodenum was then closed by a continuous catgut suture, taking all the coats, and by a double layer of Pagenstecher thread suture above this. The clamp holding the proximal part of the duodenum was now covered with a gauze swab and was lifted well towards the left, exposing the gastro-duodenal artery more conspicuously. The artery was ligatured and divided. Along the whole length of the greater curvature the gastro-hepatic omentum was divided at a distance from the stomach of from one to two inches, so that all glands, including one or two dropped glands, were left attached to the stomach. The whole stomach was now free, for the gastro-hepatic omentum had been entirely divided, the duodenum was severed, and the gastro-colic omentum ligatured and cut free. The whole stomach hung pendulous from the œsophagus. At this point the anæsthetist was asked to flex the patient's neck as much as possible, in the hope that this might enable the œsophagus to be pulled downwards a little more readily, and it seemed that this hope was fulfilled. The œsophagus was dragged upon with a fair degree of force until at least three-quarters of an inch of it was visible below the diaphragm.

"The next step, and the most important and difficult of all, was the anastomosis of the œsophagus to the jejunum. The transverse mesocolon was already exposed on its upper surface in the wound; it was divided in an avascular area and the upper loop of the jejunum pulled through

it A point on this about eight inches from the duodeno jejunal flexure was selected for the anastomosis A piece of it about two and a half inches in length was laid transversely along a line immediately behind the œsophagus As it lay there transversely the right leaf posterior, its upper end was to the left its lower to the right The anastomosis was now begun by introducing eight light interrupted sutures between this portion of the jejunum and the œsophagus The part of the circumference of the jejunum used was that on the surface which was now posterior, and on this surface about three quarters of an inch from the mesenteric attachment As the sutures were introduced into the œsophagus this was made to present and was well exposed by a forcible and continuous downward traction upon the stomach The stomach wrapped in a hot gauze swab was used and most efficiently used as a retractor or rather as an instrument of traction upon the slightly dilated œsophagus The help derived from this manœuvre was far greater than could be believed from a mere description It converted what would have been an excessively difficult feat into one of comparatively easy accomplishment Light interrupted sutures then were introduced until the whole of the posterior half of the œsophagus was securely attached to the jejunum In front of these a continuous suture was now introduced exactly as in the operation of gastro-enterostomy from left to right the needle carrying this suture was then laid aside to be presently resumed The attachment of the œsophagus to the jejunum seemed now quite secure on this posterior aspect In front of this continuous suture a small opening was made into the œsophagus and into the jejunum at the extreme left end of this attachment A continuous through and through fine linen thread suture was now begun and a few turns of the needle taken until the whole length of the small openings made had been united (*see Fig 137*) These openings were then enlarged little by little from left to right and as they were enlarged their cut edges were sutured by the same continuous stitch This sequence of a small incision a few stitches slight enlargement of the incision a few more stitches was continued until the whole of the posterior part of the œsophagus was divided and sutured to the incision in the jejunum Around the anterior wall of the œsophagus the same sequence was continued the stitch being now changed to the 'loop on the mucosa' form The result was that the stomach was retained as a tractor drawing down the œsophagus until the last piece was severed and at that moment the line of anastomosis was almost complete Finally the outer continuous suture previously laid aside was resumed and continued round the anterior surface of the œsophagus and jejunum to its starting point where it was tied and cut short The suture line was now complete There were it will be seen eight interrupted posterior sutures intended as anchor sutures and the two continuous sutures as in the usual operation of gastro-enterostomy A few anterior anchor sutures fixing the jejunum and the œsophagus to the diaphragm were now taken and the main part of the operation was now complete The great omentum was turned upwards over the operation area and the abdomen closed

The patient had borne the operation well There had been no soiling of the operation field nor any exposure of viscera As soon as the patient was put back to bed the continuous administration of saline fluid by the rectum was commenced In the first twenty four hours nine pints

were taken ; in the second twenty-four hours six pints. After this it was discontinued. The help given by the absorption of fifteen pints of normal saline solution within forty-eight hours is probably difficult to exaggerate. During this time, contrary to my usual practice, I gave no fluid by the mouth, but the patient was allowed to flush his mouth as often as he wished. He never complained of thirst and did not suffer any great amount of pain. He was kept lying flat on his back, with the head propped well forward. The administration of fluids by the mouth was begun very cautiously on the third day. Two teaspoonfuls of water were given every half-hour ; on the fourth day this quantity was increased to two ounces every half-hour. On the fifth day five ounces were given hourly ; water and peptonised milk and albumen water were given in succession. On the sixth day two pints of these fluids were taken while the day nurse was on duty and one pint six ounces during the night. These quantities of the same fluids were slowly increased until on the tenth day five pints were taken in the twenty-four hours. On the eleventh day beef-tea and Benger's food were given, on the fourteenth day milk pudding, and on the eighteenth day bread and butter. During the third week the patient told us every day that he was hungry, a sensation which he had not experienced so keenly for two years. At the end of the third week he began to take meals of fair quantity consisting of minced chicken, milk puddings, &c. He was kept in bed for eighteen days, and on the twenty-second day was sent to a convalescent hospital. On leaving the hospital his weight was 8 st. 12 lb., a gain of 10 lb. On August 21 he weighed 10 st., and was able to eat all foods.

"This is the second occasion upon which I have been called upon to perform complete gastrectomy.¹ The circumstances present in the two cases were similar ; the stomach was small, with thickened walls and a cavity greatly reduced in size ; it was invaded in every part by cancer, the glands were only slightly affected, there were few adhesions, no invasion of the parts around by the growth, and no secondary deposits. It has been computed by Fenwick² that 14 per cent. of all patients dying from carcinoma of the stomach show no extension of the disease beyond the stomach. The type of cancer in both these patients was atrophic, and the malignancy was probably of a low grade. It would seem that conditions of the kind enumerated are essential to the successful carrying-out of the operation of complete gastrectomy. In my first case, which proved fatal, I adopted a technique which I thought satisfactory. After the operation I gave much thought to the details of the operation and endeavoured to construct a method which I should carry out if the opportunity again came to me. I had determined to make use of the stomach-tube passed through the œsophagus into the jejunum as a sort of cylinder upon which to suture, and I considered that the fixation (by a catgut suture) of the tube to the cut end of both œsophagus and jejunum (the suture being, of course, buried by the continuous sutures along the line of anastomosis) would help to make the feeding of the patient during the time of healing of the wound a simple and a safe matter. But when I came to perform this second operation I realised as I saw the stomach pendulous from the œsophagus that it might be used with the very greatest advantage to hold the

¹ *Brit. Med. Journ.*, 1903, ii, 1498.

² *Cancer of Stomach*, p. 54.

œsophagus in a fixed position until my suture lines were practically complete. I feel sure that this point is one which has solved the greatest of all difficulties in the operation of complete gastrectomy, and it embodies, moreover, a technical principle which is applicable to other operations than this."

This patient gained 2 st 10 lb in weight, and made a good recovery. His appetite was good, and he was able to eat ordinary foods, but he had to take rather a long time over his meals. He remained perfectly well nearly three years, then he gradually developed a profound anæmia, from which he died, three years and eight months after the operation. At the autopsy¹ there was "complete absence of any recurrence or dissemination." The upper part of the jejunum was a little dilated just below the anastomosis.

In a very successful case operated upon by Dr Harvie, of New York,² the duodenum and œsophagus were united by direct suture, but this is neither so easy nor so safe owing to the difficulty of mobilising the latter sufficiently without interfering seriously with its nutrition, the jejunum can be joined without tension.

It is more than probable that the internal secretion of the gastric mucosa is necessary to life, for the subjects of complete gastrectomy gradually become anæmic and marasmic. This makes it important to save a little of the cardiac end.

INNOCENT TUMOURS OF THE STOMACH³

Innocent tumours of the stomach are so very rare that they are apt to be mistaken for malignant disease before, during and after operation. According to the statistics of the Mayo Clinic only 1 in every 200 gastric tumours is benign and only 1 in 550 is a myoma. Between 1907 and 1921, 2,168 patients were operated on at the Clinic for malignant disease of the stomach—2,146 for carcinoma, 20 for sarcoma and 2 for malignant polyp. During this period there were only 27 operations for benign tumour.⁴ In addition, however, 2,285 cases of inoperable malignant disease of the stomach passed through the Clinic and it is of course possible that in some of these the growth was innocent and that an exploratory operation would have corrected the diagnosis. Several of the benign tumours were mistaken clinically for malignant disease and thought to be hopeless before operation which was sometimes undertaken only at the earnest request of the patient.

The twenty seven innocent tumours were divided as follows —

Myomas	10	} Generally submucous sessile or pedunculated and freely movable
Fibromas	5	
Angiomas	4	
Dermoids	2	
Polyps (Multiple papillomata)	1	
Adenomas	2	
Polyps	3	

During seventeen years as surgeon to Guy's Hospital the writer has met and removed only three innocent tumours of the stomach—one

¹ *Lancet* 1911, ii, 430

² *Ann of Surg* 1900 i, 344

³ Abstract from article in *Guy's Hosp Reps* 1924 lxxiv, 64

⁴ G. B. Eusterman and E. G. Senty, *Collected Papers of the Mayo Clinic*, 1921, xiii, 27

adenoma and two myomata. It is interesting to contrast these two cases of myoma, and thus to show the importance of remembering the possibility of a gastric growth, although apparently hopeless, being innocent and curable by operation. In the first case, seen twelve years ago, the myoma was mistaken for sarcoma and partial gastrectomy performed in a very feeble, anæmic patient, with fatal result; in the second, seen in 1923, the tumour was at once recognised as a myoma and local resection successfully performed, although this patient also was very ill and anæmic before operation.

CASE 1.—George G., aged 49, was admitted to Guy's Hospital in September, 1911, for abdominal swelling, melæna and wasting. Patient had first felt the swelling in March, 1906, and about the same time blood appeared in his stools. He was admitted to the hospital under the late Sir Frederick Taylor for duodenal ulcer and treated for six weeks; he was then discharged apparently well. No tumour was noticed in the abdomen. On re-admission in 1911 a swelling could be felt one and a half inches above and to the right of the umbilicus. It was as large as an orange, freely movable and smooth on the surface. The patient did not vomit and had no pain or indigestion. He was very thin and extremely anæmic, having lost a great deal of blood per rectum and having been kept for several weeks on a light diet for supposed duodenal ulcer. He still had severe melæna. Respiration was normal, but his pulse was feeble and rapid.

Operation.—Incision made to the right of the middle line and the stomach exposed. A large, soft, oval swelling was found in the pyloric part of the stomach. It was so freely movable within the stomach that it was at first thought to be a foreign body, but, on feeling it carefully, it was found to be attached by a broad pedicle to the posterior wall, near the lesser curvature and about three inches from the pylorus. A crater was felt at the summit of the tumour, easily admitting the tip of the thumb. The growth was thought to be malignant, probably a sarcoma, therefore partial gastrectomy was performed at once, nearly two-thirds of the stomach being removed and an anastomosis being made between the remainder and the jejunum, after Billroth's second method. On examination the growth was found to be sub-epithelial, encapsuled and had two excoriated deep ulcers on it. Microscopically it was a myoma.

The patient died exhausted four days after the operation, the exact cause of death being uncertain at the autopsy.

CASE 2. David R., aged 67, was admitted to Guy's Hospital in April, 1923, for pain and swelling in the left epigastrium and left hypochondrium. Seven weeks before, when getting up in the morning, the patient had a sharp attack of pain in the lower part of the left side of the epigastrium. The pain passed off in a few hours but left an "ache" which continued for five weeks, when he had another attack of pain in the left side. He vomited twice during the day, on the first occasion bringing up a large quantity of black vomit; he felt weak, ill and faint and, for the first time, noticed that his fæces were black and liquid. The next two weeks he spent in bed feeling ill and giddy, and the motions continued black and loose. On examination in hospital the abdomen was found to be distended beneath the left rectus, which was rigid so that no definite tumour could be felt. Later a very movable, cylindrical swelling was occasionally felt in the epigastrium, usually in the position of the transverse colon, half an inch above and to the left of the umbilicus. It was tender on palpation and measured three inches transversely and one and a half inches vertically, but was most elusive, easily disappearing under the costal margin. Pulse 80, temperature 97, respiration 20. X-ray examination of the colon after barium enema did not show any evidence of obstruction of the colon. Chemical report of fæces: "Guaiac test positive. Hæmatoporphyrin well marked. No acid hæmatin. Altered blood present." It is probable that for some time past the patient had lost a great deal of blood by the bowel, for he was very pale and feeble. Diagnosis: Carcinoma of the colon was seriously considered, but the result of the opaque enema, the history of hæmatemesis and the great alteration of the pigments in the stools were in favour of a gastric lesion, probably carcinoma.

Operation.—April 9th, 1923. The swelling could not be felt under the anæsthetic. A left paramedian incision in the epigastrium revealed a swelling the size of

a tennis ball inside the stomach, freely movable but attached to the posterior wall near the lesser curvature a little to the right of the middle of the stomach. A crater could be felt in the globular swelling. A diagnosis of fibroma or fibromyoma was made and it was decided to remove it through the posterior wall of the stomach. An opening was made in the transverse mesocolon and the swelling was then found to involve the wall of the stomach for about an inch. A pouch including the tumour, was clamped off and an elliptical piece of the posterior wall removed with the growth which was pedunculated and submucous but had originated in the muscular coat of the stomach. The gastric wound was closed with two continuous sutures of fine catgut. The patient made a good recovery and left hospital three weeks after the operation. He has remained well since.

Pathological Anatomy—The growth was the shape of a hen's egg and the size of an orange. It was only attached to the stomach wall by a pedicle, its walls were thick and firm but its centre was hollow, soft and haemorrhagic.

After microscopic examination Dr. G. W. Nielson reported the growth to be a fibromyoma.

Pathology Most innocent tumours of the stomach develop in the pyloric segment either on the posterior or anterior wall near the pylorus. They vary greatly in size and are mostly sessile but sometimes pedunculated and freely movable. Myoma starts in the muscular wall of the stomach, projects into the cavity and like the similar submucous growth of the uterus is liable to injury from violent peristalsis and often degenerates, ulcerates and bleeds. The growth is rather soft and may easily be mistaken for sarcoma until careful microscopic examination is made, even then the adenomatous myoma removed from my first patient was thought to be a myxosarcoma. Myoma of the stomach is encapsuled and exhibits the characteristic arrangement of its large spindle cells. Sarcoma of the stomach is usually round-celled and infiltrating. In the Guy's Hospital Museum there are several examples of papillomata of the stomach of various sizes (Nos. 670 to 676) and one instance of a fibromyoma (No. 678) the size of a pigeon's egg which did not ulcerate or give rise to any symptoms.

Symptoms and Signs Myoma like other innocent tumours of the stomach may give rise to no symptoms but when it is polypoid it often causes vomiting and colicky pains from the engagement of the tumour in the pylorus and sometimes intussusception of part of the stomach into the duodenum. A polypoid tumour may block the pylorus as a large gall stone often blocks the neck of the gall bladder. It then acts as a ball valve and causes intermittent pyloric obstruction with dilatation of the stomach and periodical vomiting. This occurs in about a quarter of the cases. Haemorrhage occurs in about 37 per cent of cases and is often very severe as in the two cases recorded here. Ulceration or erosion and hæmorrhage may be partly due to violent peristalsis of the stomach. The appetite is generally good but loss of weight is sometimes severe amounting to anything from 10 to 60 lbs. A very mobile and elusive tumour may be felt in the epigastrium. The age of the patient varies very much, some being below the cancer age but the majority well over thirty-five. One of the most important clinical signs is defective filling of the stomach as shown by radiography after a barium meal. It is usual for this defective filling to be globular and near the middle of the pyloric segment. Like the tumour, it varies considerably in size. The

¹ This specimen was exhibited at a meeting of the British Medical Association at Portsmouth in July, 1923.

acidity of the gastric juice is usually normal or above normal, but there may be sub-acidity or achlorhydria, strongly suggesting malignant disease.

Diagnosis. The common mistake is to diagnose the benign tumour as malignant. An unduly movable tumour in the epigastrium, especially if it disappears at times, should make us think of an innocent tumour or a foreign body in the stomach. The long duration of the history with good digestive ability, normal or over-acidity of the gastric juice, with good general condition, and sometimes youth, should tend to exclude malignant disease. Very profuse and repeated hæmatemesis is in favour of benign tumour, especially of hæmangioma or myoma; both my patients suffering from myoma nearly bled to death before operation.

On first feeling a movable tumour in the stomach during operation, a foreign body, such as a hair-ball, suggests itself, but attachment to the wall of the stomach excludes this at once. Free mobility and absence of signs of infiltration are the most important indications of innocence.

It is very difficult to distinguish between individual kinds of benign tumours, especially between angioma and myoma, for in both these hæmorrhage and a movable tumour are the most prominent features. In most cases the diagnosis will not be established until an operation has been undertaken. Angiomata are rarely felt clinically; when seen at the operation they are soft, spongy, and bluish-black or red in colour. Multiple papillomata (polyposis) of the stomach occur in local collections and generally give a characteristic X-ray picture, the defective filling being partial or mottled on account of the barium insinuating itself between individual polypi, but this finding cannot be entirely relied upon. In two cases reported by Finney and Friedenwald,¹ and in one by du Bray² the discovery on X-ray bismuth examination of a large clean-cut filling defect led to the diagnosis of carcinoma, but the correct diagnosis of innocent tumour was made at the operation, and local removal successfully carried out. Achlorhydria, excessive peristalsis and over-secretion of mucus are usually associated with this rare condition, which is variously described as inflammatory infective warts or adenomata. Occasionally, as in the case described by C. P. Mills³ (when recording eighteen others), multiple papillomata may be associated with carcinoma of the stomach.

Operation. When the condition is recognised, strictly local resection is the best and safest operation, there being no fear of recurrence if all the tumour is removed. To ensure complete removal the whole thickness of the wall of the stomach is taken away with the tumour at its point of attachment.

Prognosis. A study of the recorded cases shows that an exploration of a gastric tumour is sometimes worth while, even when the outlook seems to be hopeless. The results of operation for innocent tumour of the stomach have been extremely good, although in cases of severe anæmia blood transfusion is necessary before operation.

¹ *Amer. Journ. Med. Sci.*, 1917, cliv, 683.

² *Arch. of Intern. Med.*, 1920, xxvi, 221.

³ *Brit. Journ. Surg.*, 1922, x, 226.

CHAPTER XI

VISCEROPTOSIS AND CHRONIC CONSTIPATION

VISCERAL PROLAPSE

THE treatment of visceral prolapse is difficult and uncertain for visceroptosis in varying degrees is common without causing trouble in healthy minded persons, whereas the neurasthenic who has unfortunately been told that her viscera have prolapsed, attributes most of her queer sensations to this misfortune. When supports have failed operations are tried, often with disappointing results. This is not surprising, for it is difficult to fix so many lax viscera, even if it were desirable and the diagnosis of visceroptosis is frequently a cloak for ignorance the true cause of symptoms remaining undiscovered. Caution is certainly desirable before embarking on such doubtful operations and patience in clinical research to seek the true cause of symptoms and when there is no evidence of organic disease, to make the best use of external supports. When at last an exploration is undertaken, it must be thorough and complete in the hope of finding, or at least excluding, organic disease before attempts are made to fix the viscera by operation. If this wise caution is observed, better and more permanent results may be expected.

Gastropexy. This is an operation for the correction of prolapse of the stomach. An attempt is made to keep the latter in its natural position by sewing it to the parietal peritoneum or by shortening and strengthening its natural supports. Gastroptosis rarely occurs alone, but rather as a part of a general visceroptosis (Glenard's disease), so that even if an operation successfully restores the stomach to its natural shape and position the patient is not necessarily cured but may have to undergo nephropexy or colopexy as well.

It is striking that the condition is almost limited to women who sooner or later, become ill nourished, thin and nervous. The patients complain of vague pains in the abdomen and back, with a sinking feeling in the abdomen, especially when they are up and about. Vomiting and increasing constipation are almost always evident. Some regard the symptoms and visceroptosis as the results of malnutrition and of a nervous and degenerative disposition others, like Rosving, think the symptoms are the direct result of the visceroptosis. He thinks the pains and nervous symptoms are due to dragging upon the nerves of the prolapsed viscera and their supports and he regards the wasting as secondary to the indigestion and constipation. He considers the pressure of tight corsets as the main cause of the prolapse, and thus accounts for the limitation of the disease to women. He describes two forms of the disease.

(a) The "Virginal," which occurs in women who have not borne children and whose abdominal walls are therefore unstretched and

strong. In these the prolapsed stomach finds too little room in the unnatural position between the strong muscles and the lumbar spine, and becomes folded and kinked, with much pain, vomiting and even hæmatemesis as results. The symptoms are often somewhat relieved by childbirth, but an abdominal support is useless or intolerable and an operation is indicated.

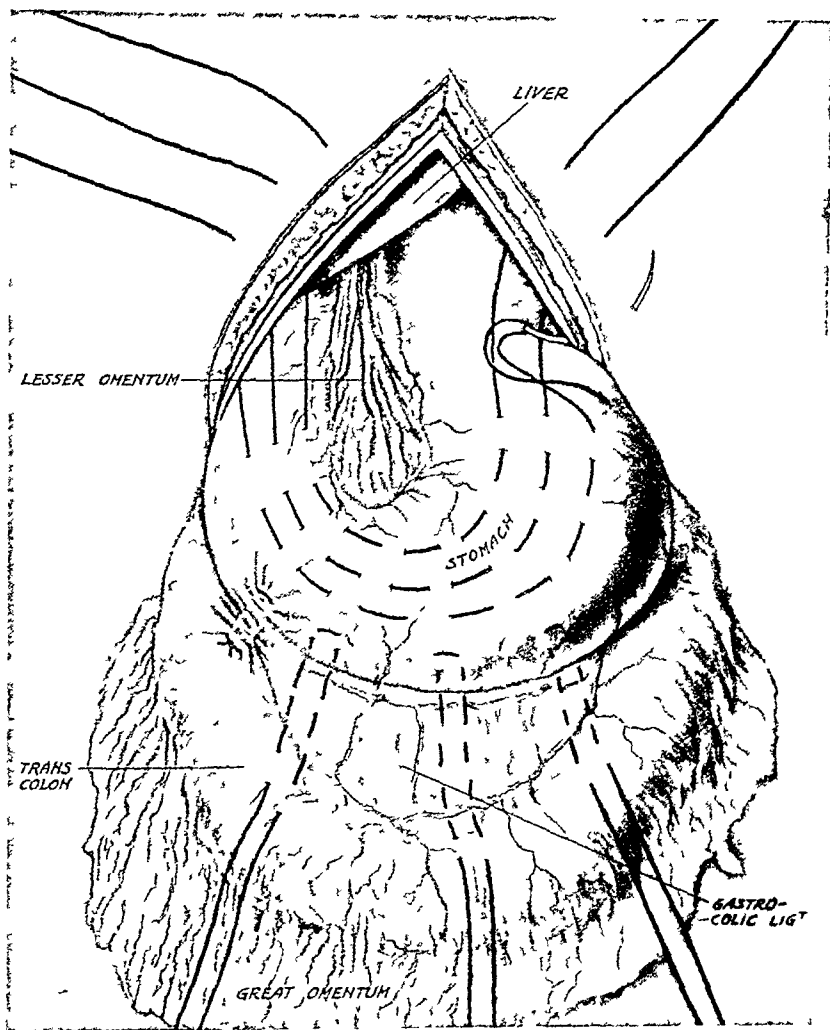


FIG 138 Rosving's operations of gastropexy and colopexy Sero muscular sutures support the stomach and colon

(b) The "Maternal," which occurs in multiparous women with thin and flabby abdominal walls. These women have less pain and complain chiefly of constipation. In these cases a good abdominal support pressing the lower part of the abdomen upwards and backwards is generally sufficient.

In some cases there is delay in emptying the stomach owing to dragging and kinking at the pylorus when the patient is upright. The stomach dilates or hypertrophies or both. The delay and dilatation

are best shown by examining the patient with the X rays both in the vertical and recumbent positions after a meal containing bismuth oxychloride

Different views are held about the value of operation in these cases. Most surgeons advocate abdominal supports, but it cannot be said that these are always successful. Others believe that operations are occasionally necessary and others that operations should be done far more often and early enough to prevent serious symptoms and nervous phenomena. They should never be done before the abdomen has been

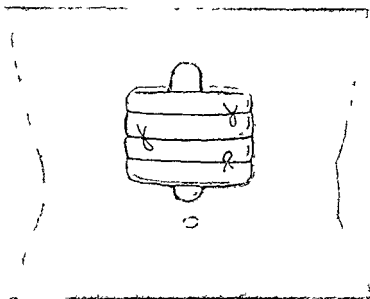


FIG. 130 Rossing's operation of gastropexy

thoroughly explored and all other possible causes of the symptoms have been excluded. Special attention should be directed to the stomach, gall bladder, appendix and pelvic viscera.

Operations (a) *Duret's Operation* Duret of Lille² was the first to perform gastropexy and his patient was greatly relieved and gained much weight. He made a vertical incision in the middle line above the umbilicus, only opening the peritoneum at the lower part of the incision. He then passed a single silk suture first through the left rectus, the parietal peritoneum and the sero-muscular coats of the stomach just below the lesser curvature and then forwards through the undivided parietal peritoneum near the upper end of the wound. In a similar way the needle picks up the stomach and parietal peritoneum several times until at last it is brought out through the right rectus. The ends of the suture are tied, thus bringing the lesser curvature into close contact with the parietal peritoneum. Objections to this method because it puckers the lesser curvature

² *Revue de Chir.* 1896 p. 430

(b) *Rosving's Operation.* Rosving¹ thus describes his operation :

Parallel with the lesser curvature I lead three strong silk threads in and out through the serous coating of the anterior surface of the stomach, leaving the pyloric portion free. The upper thread is placed close under the lesser curvature, and the two others, with an interval of about 2 cm., are placed in such a way that the greater curvature and a rather large piece of the wall above this are left free (Fig. 138). With a fine needle the serosa coating between the threads is now scarified in all directions, also the surface of the parietal peritoneum, and eventually that part of the under side of the liver to which one wishes the stomach to adhere. The ends

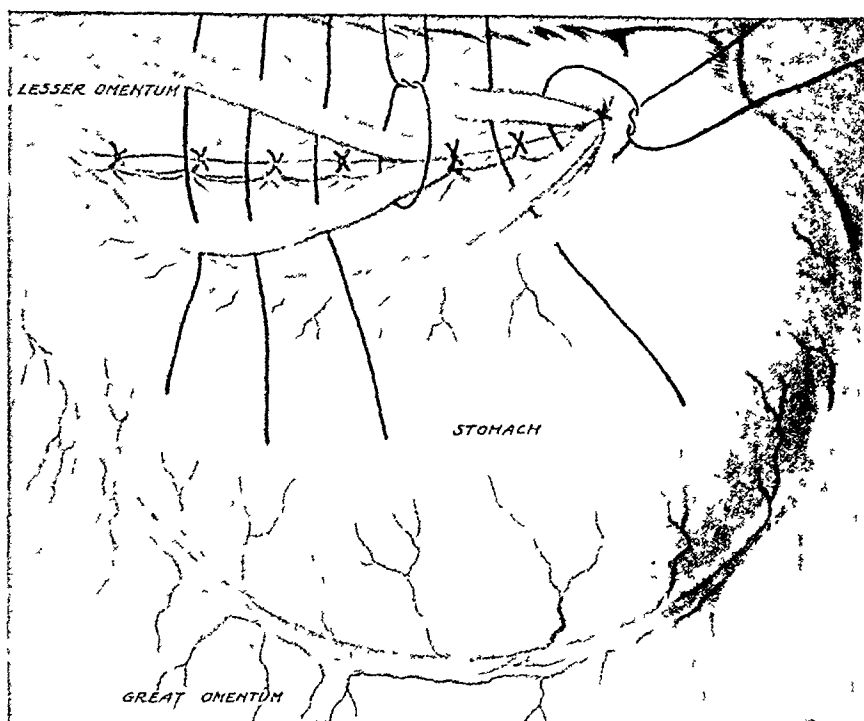


FIG 140 Beyea's method of gastropexy.

of the silk threads are led out through the entire thickness of the abdominal wall that on the left as far as the side of the rib-curve, and that on the right at about, 3 cm. to the right of the centre line. The peritoneum is now joined with catgut, and the fascia and skin with aluminium bronze, and, after the line of the wound has been covered with collodion and cotton-wool, the silk sutures are tied over a glass plate covered in sterile gauze (Fig. 139), the dimensions of which are a little larger than the stomach surface which has to be fixed. In this way it follows that the anterior surface of the stomach lies flat and close to the abdominal wall, without shrinkage and folding. These threads are left for four weeks and are then easily removed. A perfectly secure and solid adhesion is thus obtained.

After having employed this method with excellent results in 90 cases I allowed myself, in 1907, to be induced by Cannon's investigation as to the importance of the pre-pyloric part of the stomach with regard to the mechanical manipulation of food to modify my operation in such a way that I left the entire pre-pyloric part free, and only fixed the fundus with the aid of three silk threads, which passed transversely over the axis of the stomach and which were tied over a glass plate to the left of the centre line. With the systematic after-examination of all the cases treated with gastropexy up to January 1, 1911, the results from the latter

¹ *Ann. of Surg.*, 1913, lvii, 19.

method have proved to be far inferior to those of the former because, while the former gave 60 complete cures in 94 cases, the latter gave only 29 cures in 69 cases. For this reason I have returned to the former method, and have employed it with my last 30 cases, the results so far being excellent.

Since 1897, when I performed my first gastropexy, till January 1, 1911, I have myself performed the operation 163 times, and have received information from other Scandinavian surgeons of 93 operations performed in accordance with my method. All these 256 patients have been traced and their condition since the operation carefully examined, with the following result:—

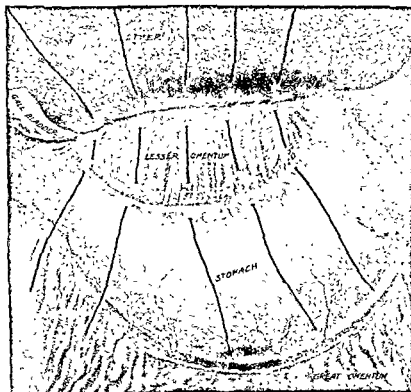


FIG. 141. Eve's method of gastropexy.

Analysis of results obtained in 256 Gastropexies.

	Per cent.
Complete cure	162 = 63.2
Great improvement	33 = 12.8
Improvement	18 = 7
Slight improvement or no change	32 = 12.8
Deaths	11 = 4.6

In all cases where the gastro-colic ligament is considerably elongated, one does not obtain by gastropexy pure and simple a lifting of the colon sufficient to remove the constipation.

In order to obtain this a special operation is required, and some of my less successful cases in earlier days are surely due to my non-appreciation of this and to later experiments with various inferior methods. Here, the right operation has proved to be the shortening of the omentum and the mesocolon by basting this with the aid of a row of thick catgut threads, which commence in the serous coating of the colon and end at the greater curvature.

(c) *Beyea's Operation*.¹ Through a similar but shorter incision Beyea shortens the gastro-hepatic and gastro-phrenic ligaments by plicating them with three rows of interrupted silk sutures, each suture, when tied, making a transverse fold (see Fig. 140). Bier shortens the small omentum in a similar way and also fixes the pylorus to the capsule of the liver. Both Beyea and Bier have had good results. Eve and Moynihan speak well of this method. With the last row of sutures Moynihan picks up the sero-muscular coats of the stomach just below

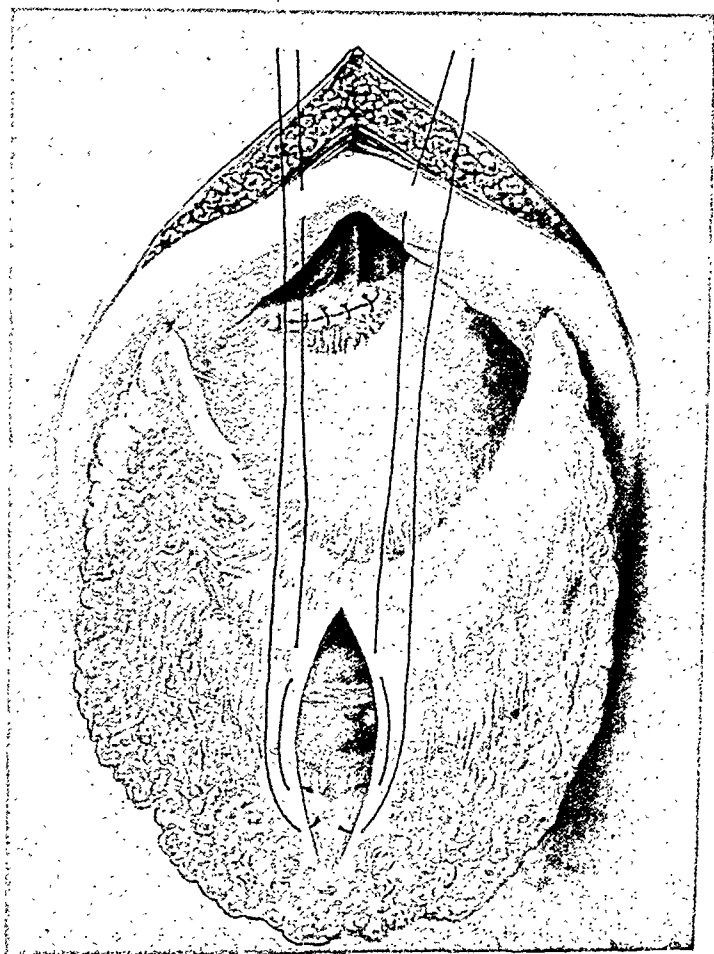


FIG. 142. Coffey's operation. The stomach and transverse colon are slung up by sutures passing through the parietal peritoneum, the gastro-colic and great omenta. The small omentum has been plicated; more sutures are used.

and in front of the lesser curvature. The lesser omentum is often so thin and frail, especially at its lower part, in these cases that it is impossible to suture and fold it. Therefore Eve sews the stomach just below and in front of the lesser curvature by five or six interrupted sutures to the under surface of the liver just in front of the transverse fissure. He leaves the pylorus free and, therefore, a little lower than the

¹ *Phil. Med. Journ.*, 1903, i, 257.

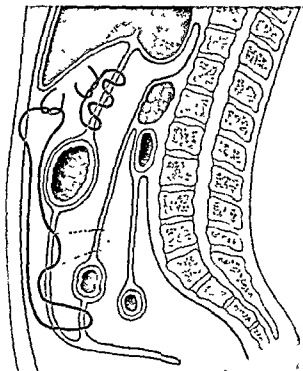


Fig 143 Coffey's operation. Vertical section showing the effect of the 'hammock' sutures. Sutures placed in the parietal peritoneum, omentum and transverse mesocolon.

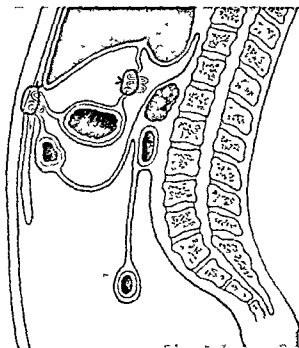


Fig 144 Coffey's operation. Vertical section showing the effect of the 'hammock' sutures. Sutures tied suspending the stomach and colon.

lesser curvature (see Fig. 141). He reports eleven cases with fairly good results, but only three of the patients had been watched for more than a year¹ (see figures).

(d) *Coffey's Operation.*² Coffey sutures the gastro-colic omentum about one and a half inches below the greater curvature and the great omentum just below the transverse colon with interrupted chromicised catgut sutures to the parietal peritoneum along a transverse line about two inches above the umbilicus. The width of attachment is varied with the need.

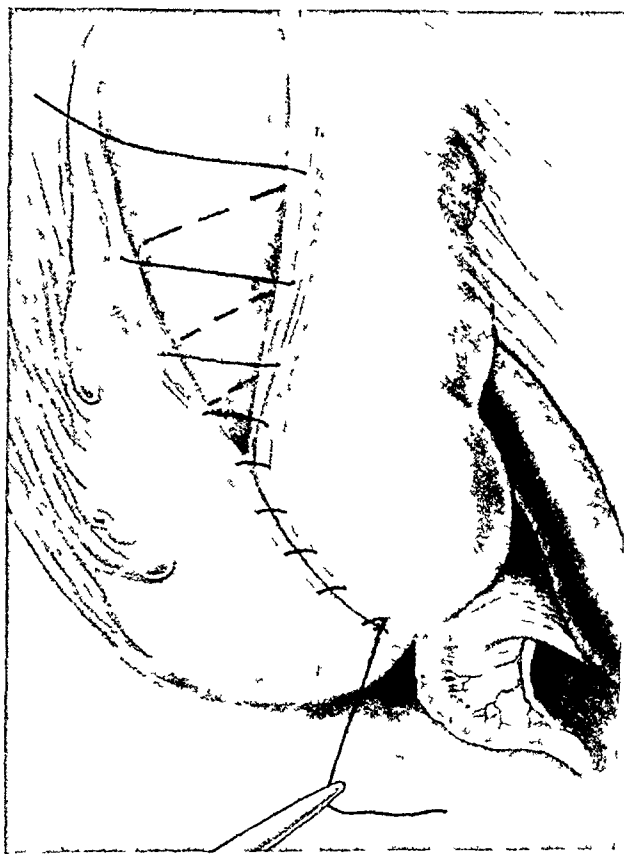


FIG 145. Method of pleating a large pendulous cæcum

Generally three to five sutures are passed to the left and two or three to the right of the mid-line. L. S. Pilcher passes some of the stitches through the transverse mesocolon to give greater support.

Coffey makes his incision exactly in the middle line from the ensiform cartilage to an inch below and to the left of the navel. He separates the recti without opening their sheaths and turns inwards a flap, about an inch wide, from the front of each rectus, in order to give more room in the upper abdomen when the latter is closed by joining the free edges

¹ *Brit Med Journ*, 1910, 1, 1100.

² *Phil Med Journ*, October 11, 1902, and *Gastro-Enteroptosis* (D. Appleton & Co, New York), 1923, 218

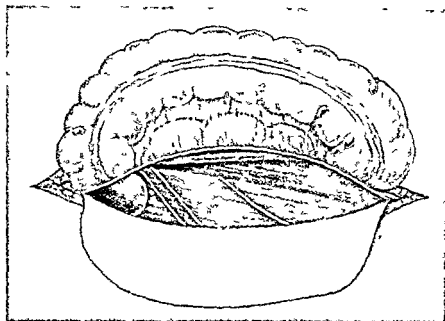


FIG 146 Waugh's operation for fixing and fixing the cecum. A flap of parietal peritoneum and iliac fascia has been turned out displaying the lower pole of the kidney and branches of the lumbar plexus with the psoas and iliacus

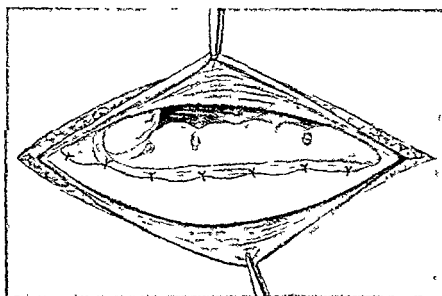


FIG 147 Waugh's operation. The flap already mentioned has been stitched to the anterior longitudinal band of the ascending colon and cecum

of the aponeurotic flaps. When it appears necessary to raise and fix a pendulous cæcum and ascending colon, Coffey pleats the latter by sewing two longitudinal bands together and the colon to the parietal peritoneum.

Waugh¹ fixes the ascending colon and cæcum partly in a retro-peritoneal pocket in the right flank after incising the peritoneum to the right of the ascending mesocolon and sewing the left edge of the peritoneal and fascial flap thus raised to the front of the colon and cæcum. Subsequent radiographic examination, however, does not show any elevation

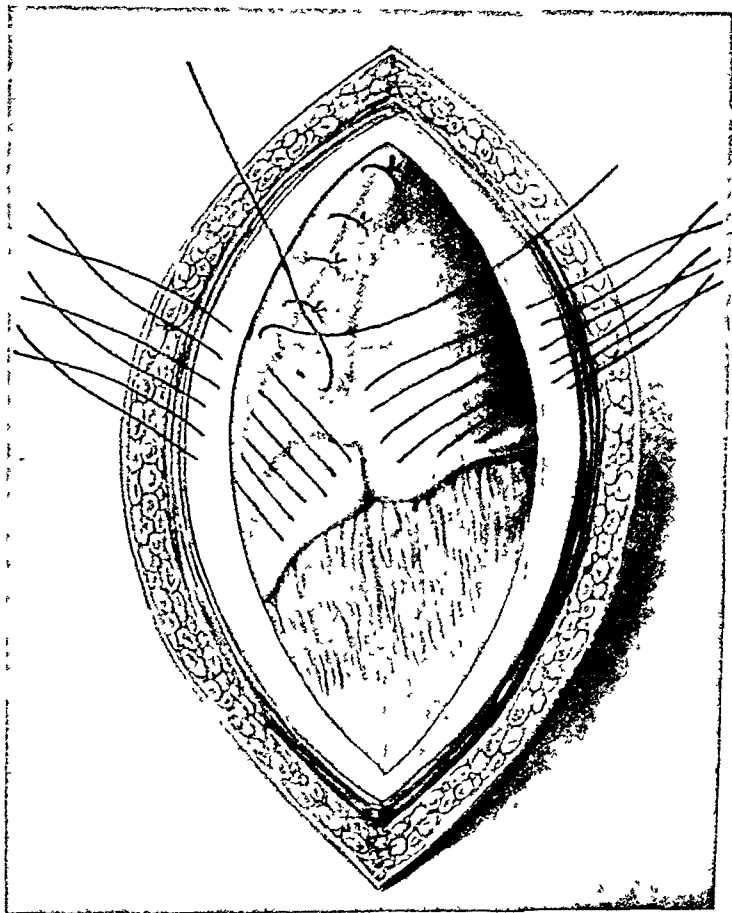


FIG. 148. Shortening the falciform ligament and fixation of the liver.
(Modified from Coffey.)

of the hepatic flexure, and kinking of the colon may result. Although considerable immediate relief of symptoms has often followed the operation, relapses are not uncommon, and there is reason to fear its too frequent adoption.

The treatment of undue mobility of the pelvic and left iliac colon is discussed under Volvulus and Prolapse of the Rectum.

Hepatopexy. Prolapse of the liver is generally part of a general visceroptosis, or Glenard's disease. It causes few symptoms and an abdominal belt suffices for its treatment.

¹ *Brit. Journ. Surg.*, 1920, vii, 343.

Coffey shortens the falciform ligament with purse string sutures of chromicised gut and then sews the edges of the lateral lobes to the parietal peritoneum. Francke added a gauze pack passed between the liver and the diaphragm retained for a week to make adhesions there.

Splenopexy and Nephropexy are discussed elsewhere.

CHRONIC CONSTIPATION OR CHRONIC INTESTINAL STASIS

Chronic constipation was fully discussed before the Royal Society of Medicine in March 1913 and again in 1922.¹



FIG 149

Widely different views are held concerning the *causes results* and especially the *treatment* of constipation. Sir Arbuthnot Lane believes the chief cause to be the erect position with the consequent formation of suspensory ligaments and membranes which later cause kinking of the intestine. He thinks the results disastrous to health chiefly from the absorption of toxins causing widespread degeneration and disease. He attributes such common diseases as appendicitis gastric or duodenal ulceration cholelithiasis and many others to one common primary cause—chronic intestinal stasis. He considers the treatment of the severe forms to be chiefly surgical. Most physicians and surgeons however do not recommend operative treatment unless there is definite evidence of mechanical obstruction.

INDICATIONS FOR OPERATION

Every endeavour should be made to arrive at an accurate diagnosis of the existence the cause and site of delay and suitable medical treatment should be patiently tried. If this fails and the patient's health is deteriorating the abdomen should be explored and if a definite mechanical obstruction is discovered this should be treated by a suitable operation. In many cases it is sufficient to divide adhesions and remove an adherent

¹ *Proc Roy Soc Med* 1913 vi *R S M D s* p 1 and 1922 vii *Sec Proctol* p. 54

appendix or diseased gall-bladder. In some cases a short-circuit is necessary, especially a gastro-jejunostomy for duodenal stenosis, or duodeno-jejunostomy for duodenal ileus. When there is an irremovable obstruction anywhere the short-circuit should be as near as possible to the obstruction, provided that healthy parts can be joined without tension.

In some cases a volvulus causing incomplete obstruction can be uncoiled and excised or secured against recurrence by suture, or a short-circuit at the base. I have tried all these methods for chronic volvulus of the pelvic colon and found excision much the best. I have not performed complete colectomy for constipation except in one extreme instance



FIG. 150.

of enormous dilatation of the colon (Hirschsprung's Disease) and the patient died of acute dilatation of the stomach soon afterwards. When no mechanical obstruction can be discovered, either atony or imperfect innervation of the bowel with prolapse or the purge habit is the most probable cause of the constipation. Colopexy may be tried in such cases.

Dr. A. F. Hurst has kindly allowed me to use the following quotation from his excellent and well-known work on constipation:—

“When constipation is the result of definite organic obstruction of the intestine, surgical treatment is clearly indicated. But various operations have been recommended for the relief of constipation in the absence of this clear indication, and consequently the results hitherto obtained have only been satisfactory in a comparatively small proportion of cases. Though I have sometimes seen extremely gratifying results follow the surgical treatment of constipation, it has to my knowledge been the direct cause of death in several cases, and I have been consulted by patients

whose condition afterwards was either no better or was actually worse I am therefore convinced that surgical treatment should only be recommended for chronic constipation if all of the following conditions are fulfilled

(1) Prolonged medical treatment which includes much more than the mere use of aperients has failed to give relief By relief I do not mean cure as many patients continue to be completely relieved of their constipation and the symptoms to which it has given rise so long as they continue medical treatment if for example a patient remains perfectly well but has regularly to take certain drugs or requires an enema every morning he should be content with this rather than run the risk of the incomplete relief the entire failure or even the aggravation of symptoms or death which may however rarely result from an operation

(2) An accurate diagnosis is essential It is quite unjustifiable to perform any operation for the relief of constipation until all means have been taken to discover its exact cause The part of the bowel in which stasis is present must be accurately determined as well as the presence or absence of dilatation narrowing or adhesions in the case of the latter an attempt must be made to ascertain how far if at all they interfere with the normal intestinal functions An X ray examination of the stomach and intestines should therefore always be carried out and the rectum and pelvic colon should be examined with the sigmoidoscope as well as with the finger The stools should be inspected both whilst the patient is being treated and whilst the treatment is temporarily stopped and in some cases they should be examined chemically and bacteriologically Lastly the history should be taken with great care and the patient's other organs thoroughly examined in order to determine whether the intestinal condition is primary and the cause of all the symptoms I have seen two patients die as the direct result of the operative treatment of their constipation which was really secondary to a gastric and duodenal ulcer respectively and I know of cases in which the constipation and other symptoms were due to neurasthenia and in which an operation had the natural result of producing only a slight temporary improvement or no improvement at all

(3) The operation should be chosen to suit the particular condition found It is clearly absurd to recommend appendicostomy ileo sigmoidostomy or colectomy as the routine treatment for a condition which has such a manifold pathology as constipation In some of the rare cases in which surgery is required one or other of these operations may be indicated but in others an operation devised to short-circuit or excise the affected part only and not the whole colon should be performed

(4) The dangers and possible unpleasant sequels of the operation should be weighed against the severity of the symptoms for which it is proposed to operate I have on several occasions been appalled to hear from patients for what trivial symptoms they were contemplating a recourse to surgery Appendicostomy is apparently quite free from danger to life but in rare instances unpleasant local complications have occurred All the other operations which have been recommended for constipation have a slight but definite danger The mortality of simple short-circuiting operations is indeed very small but it is greatly increased if adhesions are divided at the same time and the mortality of partial

and, to a still greater extent, that of complete colectomy is high, even in the most skilful and experienced hands. It is clear, therefore, that such operations should not be lightly recommended, and that they should only be performed for symptoms which are really severe enough to interfere considerably with the enjoyment of life or with the performance of the professional or other duties of the patient.

“(a) **Division of adhesions.** Believing peritoneal adhesions to be a frequent cause as well as a result of intestinal stasis, in his earliest cases Lane¹ attempted to relieve the latter by dividing the adhesions. The results obtained were, however, unsatisfactory, as it was very difficult to prevent the adhesions from forming again, even if all raw surfaces were covered by peritoneum and complete hæmostasis was obtained before the abdomen was closed. Moreover, it is probably quite exceptional for adhesions in connection with the colon to give rise to sufficient obstruction of its lumen to cause a degree of stasis which cannot be overcome without difficulty by medical means.

“More recently Lane has ascribed a very important rôle to the bands which form in connection with the end of the ileum. He believes that in some cases their division is all that is necessary to cure a case of intestinal stasis, although when they are very widespread, especially in females, he performs an ileo-sigmoidostomy instead of merely dividing the bands. I have, however, already explained how the importance of Lane's iliac kink has been exaggerated and shown that it is doubtful whether in the absence of appendicitis it even produces sufficient obstruction to cause stasis. Moreover, Lane² has himself pointed out that the division of bands and membranes in such cases may lead to general peritonitis; I have myself performed the post-mortem on a patient with duodenal ulcer, in whom death had resulted from post-operative infection in the right iliac fossa after adhesions in the neighbourhood had been divided in addition to performing gastro-enterostomy, and Hughes,³ having seen death from general peritonitis occur on at least two occasions from division of extreme iliac kinks, expresses his belief that it is incorrect treatment to divide the adhesions causing any but the slighter form of iliac kink, although these would appear to be the ones which least require dividing. Lastly, according to Fagge,⁴ the operation often produces considerable disturbances owing to paralytic distension. . . .

“(b) **Short-circuiting operations.** The first short-circuiting operation for the relief of constipation was performed by Mansell Moullin⁵ in 1900; he made a lateral anastomosis between the last part of the ileum and the pelvic colon without dividing the ileum. Shortly afterwards Lane, having found that simple division of adhesions did not give satisfactory results, began to treat cases of chronic intestinal stasis by division of the end of the ileum, which he implanted into the pelvic colon. In numerous papers Lane described the results of his operation, which he performed on a very large number of patients suffering from the very varied conditions which he ascribes to chronic intestinal stasis. In a number of

¹ *Operative Treatment of Chronic Constipation*, London, 1904; *Brit. Med. Journ.*, 1908, i, 126.

² *Proc. Roy. Soc. Med.*, 1913, Supplement to vol. vi, p. 115.

³ *Ibid.*, p. 231.

⁴ *Ibid.*, p. 215.

⁵ *Trans. of the Med. Soc.*, 1901, xxiv, 199, and *Lancet*, 1909, i, 156.

in one instance, and between the limbs of the splenic flexure in the other, with satisfactory results.

“The comparatively rare cases in which the whole of the bowel is involved are generally amenable to treatment by diet, massage and drugs.”

On another occasion Hurst¹ says: “There is no surgery of habitual constipation. Ileo-sigmoidostomy and partial and complete colectomy are, or should be, dead. Grave organic disease leading to intestinal stasis is not included under ‘habitual constipation’; it calls, of course, for operation. But in the absence of this, surgery is as much out of place in disorders of the colon as it is in functional disorders of the stomach.” And again:² “The statistics of Guy’s Hospital show that the mortality in total colectomy for intestinal stasis is about 16·5 per cent. . . . In contrast to the 40 colectomies performed at Guy’s in 1914, only one was performed in 1920, and not one in 1921.” Sir Berkeley Moynihan,³ in giving the results of his operations for intestinal stasis, recorded 60 cases of primary excision of the end of the ileum, cæcum and ascending colon, with two deaths.

I cannot leave this subject without giving my personal views very briefly. I am familiar with all degrees of acute and chronic intestinal obstruction due to congenital and pathological adhesions and contractions at different parts of the abdomen, especially those that follow severe attacks of appendicitis, cholecystitis and other inflammatory affections, and I have frequently operated for these, often releasing the bowel at the obstruction, and sometimes performing a suitable short-circuit or colopexy; the latter has the merit of doing little harm although it may do no good in many cases. I have often seen the various bands which are still said to be the causes and results of chronic constipation. They exist in healthy individuals and, within the bounds of health, they vary considerably in character and extent. It is possible they occasionally do harm, but I do not believe they commonly cause constipation or demand any treatment.

The causes of constipation are numerous, but chronic inattention to the normal daily habit is the most important one. Neglect interferes with the normal reflex act of defæcation and leads to absorption of fluid from the fæces, leaving them dry and difficult to expel. Many children become constipated in this way, simply because they hate the trouble or interruption entailed by the act of defæcation, or because they are not made to try at the right time, while the contents of the rectum are soft. The pain entailed in expelling large hard scybala causes further fear and delay. On examining the rectum it is found to be full, and local stimulation produces the desired effect without resort to drugs. A little perseverance establishes regular habits and prevents the development of life-long constipation with atony of the bowel.

Similarly, nervous, pre-occupied and overworked people are very apt to become constipated because they are too modest, lazy or careless to adopt regular habits, and choose unsuitable foods which do not promote peristalsis. They often eat and drink too little, and they take little or no exercise. In time atony and dilatation of the colon results, sometimes with much elongation, kinking, or even volvulus.

¹ *Lancet*, 1923, ii, 134.

² *Med. Essays and Addresses*, 1924, pp. 147, 148.

³ *Proc. Roy. Soc. Med.*, 1921–22, xv, *Sec. Proctol.*, p. 54, and *Abdominal Operations*, 1926, i, 208.

CHAPTER XII

INTESTINAL SURGERY

INTRODUCTION

THE peculiarities of the structure and contents of the intestine call for the greatest refinement of technique in order to ensure complete success. Although the blood supply of the small intestine is very good, rough handling and damage to it or its blood vessels are very liable to be followed by necrosis. The contents are very septic, especially in the lower part of the bowel. This is true in spite of care in clearing out the bowels and in giving only sterilised food for some days before the operation. On the other hand, the contents of the stomach and duodenum can be made almost innocuous in this manner. The contents of the small intestine are always liquid and are therefore more liable to leak than the more solid faecal matter in the colon. The contents of the cæcum also are usually fluid. These peculiarities of the small intestine make slight errors of technique which would be immaterial in other parts, very dangerous here. There is however some advantage in the length of the bowel, for large portions of either the small intestine or of the colon can be removed when necessary without any apparent ill effect on nutrition.

Intestinal Identification and Localisation The speedy and certain identification of different parts of the intestine is often of vital importance. Grave mistakes have been made from want of care and knowledge, e.g., the colon and ileum have been mistaken for the jejunum during gastro-jejunostomy. Adhesions and other pathological changes some times add greatly to the risk of such mistakes. The large intestine is distinguished from the small by its longitudinal bands, sacculi, appendices epiploicæ, comparatively large size, fixation and fairly constant position, but in infants these points are not always obvious.

The Small Intestine The great length (fourteen to twenty five feet) and free mobility of the small intestine make it difficult or impossible to localise a chance coil with accuracy. The only parts that can be identified at once are the duodenum, the origin of the jejunum and the lower end of the ileum, for these are fixed and nearly constant in position. The only certain way of localising any other coil is to follow the bowel either up or down to the duodenum or cæcum. In the absence of adhesions this can be soon done and without undue exposure, for only a short length of bowel need ever be outside the abdomen. Certain other points are valuable in arriving at rough conclusions. The small intestine, like the colon, narrows as it descends, and gets thinner and paler. The jejunum is much thicker, larger, redder and softer than the ileum, valvule conniventes can be recognised in it by drawing it between the finger and thumb, and numerous white lacteals are generally visible upon its surface.

Mall and Monks have shown that the upper third of the small intestine usually lies in the left hyponchondrium, the middle third in the middle

of the abdomen, and the lower third in the right iliac fossa and pelvis. Monks has also shown that the direction of the current in any coil can be swiftly ascertained by tracing its mesentery back to the spine. As is well known, the attachment of the mesentery runs downwards and to the right from the duodeno-jejunal flexure, about six inches towards the ileo-cæcal valve. If no twist is found as the mesentery is traced back to its attachment, the distal end of the coil is below and to the right. In the presence of extensive adhesions this point may be of great value when relieving intestinal obstruction by anastomosis. The mesentery gets thicker as it descends; that of the jejunum is quite thin, and when held to the light its blood-vessels can be seen to be larger, their arcades fewer and the vasa recta, extending from these to the bowel, longer than those of the ileum. Definite oval, clear areas can be seen between the vasa recta in the upper third of the bowel.

The Large Intestine. The large intestine is far more constant in position, so that its parts are more easily identified. Occasionally it is transposed with or without transposition of other viscera. More commonly a partial transposition is found. For instance, the iliac and pelvic colon may lie on the right side in the iliac fossa and pelvis. Sometimes undue mobility of the ascending colon and cæcum may simulate transposition by allowing the cæcum and appendix to move freely so that appendicitis may cause a swelling on the left side.

In infants and children the cæcum is commonly higher than in adults, a fact of considerable importance when operating for acute appendicitis in children. In others, especially in women and the subjects of chronic constipation, the cæcum and appendix are unusually low in the pelvis. Even in some adults the cæcum is found just below the liver, and in some cases the appendix is near the foramen of Winslow. It is frequently found extending behind the colon as far as the lower pole of the right kidney.

The transverse colon is sometimes so low that it can be mistaken for the sigmoid, but this mistake should not be made owing to attachment of the great omentum to it. The cæcum is easily recognised by the termination of the ileum in it, and by its usual position at the back and outer side of the right iliac fossa, its bluish colour, thin texture, and mobility. Usually there is no mesocolon in either flank, but occasionally there is a well-developed one, especially on the left side. The absence of the usual wide retro-peritoneal surface of the colon interferes with the performance of extra-peritoneal lumbar colostomy. It is of greater importance that the fixation and peritoneal relations of the ascending and descending colon have been allowed to interfere with the surgery of this part of the bowel. For instance, the fixation makes it difficult either to bring the ascending or descending colon to the surface, either in front or behind, for making a proper artificial anus. It also makes it difficult to join up the bowel after the free removal of growths. These difficulties can be easily overcome by incising the lateral peritoneal reflexions and mobilising the colon without interfering with its blood-supply, which enters on the mesial aspect. The bowel, when mobilised by gauze dissection in this way, swings freely, and this fact, long unrecognised, is of the greatest value. Moreover, the fear of leaving a raw surface in the abdomen as long as it is not a pocket has

been greatly exaggerated. The difficulty of getting peritoneal apposition behind the bowel in end to end union can be similarly overcome peritoneal flaps being easily available. At the junction of the mobile transverse colon, cecum or sigmoid with fixed parts of the colon, kinking and volvulus are apt to occur.

Methods of Sewing Wounds in the Intestine From time to time numerous methods have been devised but most of them are obsolete. I shall only refer to a few here those with which I am personally acquainted and which I know to be simple and efficient. The essentials of a good intestinal suture are—

- (i) *Simplicity* It must be capable of easy and rapid introduction.
- (ii) *Accuracy* It must close the wound accurately producing good peritoneal inversion without causing undue projection into the lumen of the bowel.
- (iii) *Security* It must hold the parts securely together until the wound has firmly healed.
- (iv) *Hæmostasis* The turns of the suture should be close enough together to secure all blood vessels but the danger of hæmorrhage is not so great as in gastric surgery.

For all these reasons a continuous suture is now universally considered to be much better than a series of interrupted ones. In the introduction of the suture attention should be paid to the following points—

(a) As far as possible all knots upon a suture which pierces the mucosa should be within the bowel otherwise they may draw septic fluid from within to the peritoneal surface.

(b) All turns should be hidden by the inversion which they should produce. When these precautions are taken there is little risk of infection of the peritoneum by fluids soaking along the sutures from the interior of the bowel. A well introduced Connell's suture meets this ideal. In any case each suture should take a sufficiently firm hold so as not to cut out when any strain is put upon it—e.g. by peristalsis or distension. Sero-muscular stitches are very apt to tear out when the tissues become inflamed and softened after three or four days and the tough submucous coat cannot be included with any certainty or even probability for it is much thinner than the intestinal needle in common use (see Fig 151). The submucous and mucous coats are far more fibrous and durable than their outer coverings therefore it is necessary to pierce them in order to obtain a firm and lasting hold for the sutures. The success of the Maunsell and Connell sutures is chiefly because they maintain inversion of the edges of the wound and accurate peritoneal apposition. They are also tied within the lumen and this determines capillary drainage inwards towards the knots and facilitates the discharge of the threads into the intestinal canal without risk of peritoneal infection. Many so called sero-muscular sutures pierce the mucosa of the small intestine.

(c) The suture should be just tight enough to secure accurate apposition and stop all bleeding but it should not be so tight as to cause necrosis of the tissues engaged by it. For the same reason the turns of the suture should not be too near each other. As a rule these should be one eighth of an inch apart.

(d) The suture material must be fine, strong, durable and non-porous. Fine linen thread (No. 90 or 60) best fulfils all these ideals. Black thread has the advantage of being more visible. Chromic or formalin catgut, No. 0 or 00, also makes a reliable suture, but the advantages rightly claimed for an absorbable deep stitch for gastro-jejunostomy do not apply here owing to the absence of an acid secretion.

(e) *Needles.* The sutures are best introduced by a fine round-bodied needle, which makes a small hole that is at once plugged by the thread which follows. Quarter-curved needles are most convenient to introduce

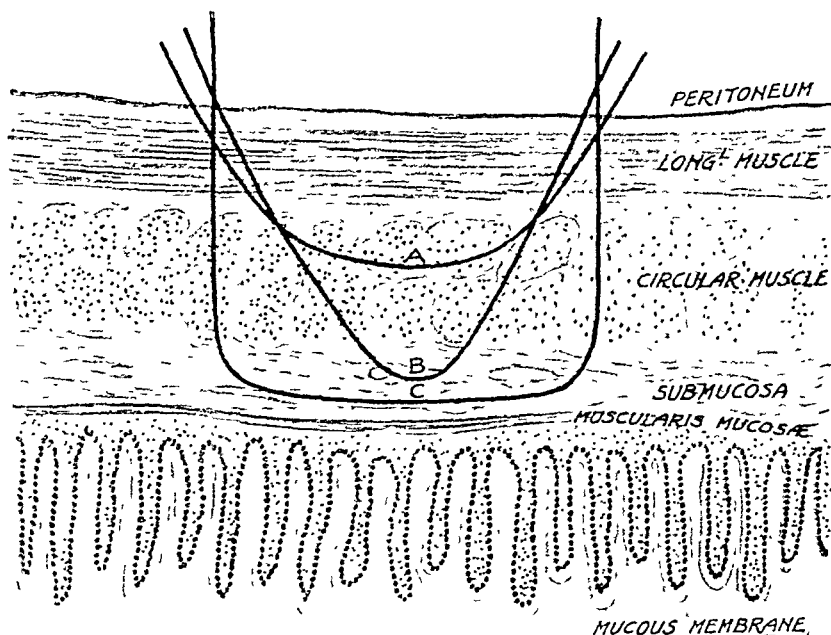


FIG. 151. Longitudinal section of intestinal wall. A, B and C show bad, indifferent and good methods of inserting sero-muscular sutures. The sub-mucosa is the toughest layer. Sutures piercing all the layers hold the longest and are always used, either alone or with others.

the sutures from within or at a depth. I always use a curved needle of this type and have it made not only fine, but also long enough to be easily held with the thumb and forefinger without the need of a needle-holder. The fingers are far quicker and more accurate than a needle-holder, except when working in a deep cavity such as the pelvis. As far as possible all sewing of the intestine is done outside the abdomen, where the work can be completed with more ease and accuracy and packing off is more thorough. It will save much time to have several needles threaded beforehand.

Clamps are invaluable in intestinal surgery for the reasons already mentioned under gastro-jejunostomy. They must be well chosen and used with gentleness and care.

CHIEF METHODS OF SUTURE

A. Serosal or Sero-muscular Sutures.

(1) *Lembert's Suture* (Fig. 152). (a) *Interrupted.* This fulfils in an eminent degree the condition first pointed out by its introducer, that to obtain union of an intestinal wound it is absolutely needful to bring and

keep the serous surfaces in contact. Each suture should be inserted about one-eighth of an inch from the cut edge and run along deeply in the muscular or in the submucous coat. It is then made to emerge just wide of one cut edge, reinserted just beyond the opposite edge, then at

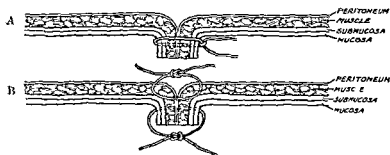


FIG 152 A shows Connell suture and the others on it produces B shows Lembert and Maunsell sutures

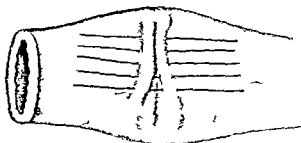


FIG 153 Intermittent Lembert sutures

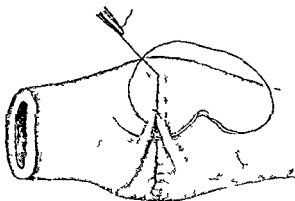


FIG 154 Continuous Lembert suture

once made to travel between the coats and to emerge as before (see Fig 153)

(b) A Continuous Lembert Suture is far more often used now because it saves so much time and secures better apposition (see Fig 154). The objections that have been brought against it are chiefly—(1) If one part of

it becomes loose the whole is liable to become insecure. (ii) It is difficult to secure even tension all along the line, unless care is taken to keep the thread always taut. (iii) If the bowel contract, the whole suture may become loosened and the wound gape; this calamity is far more likely

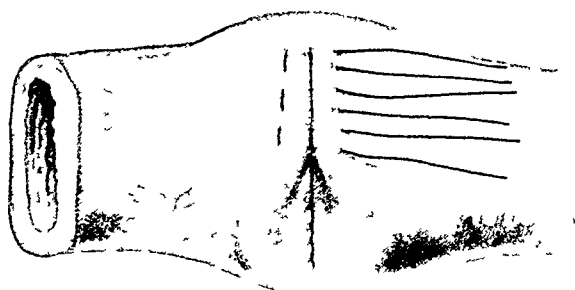


FIG. 155. Interrupted mattress sutures (Halstead)

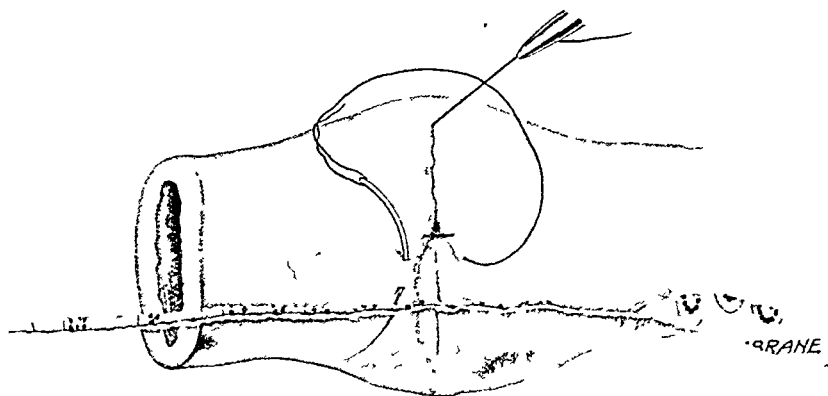


FIG. 156. Continuous serous mattress suture (Cushing).

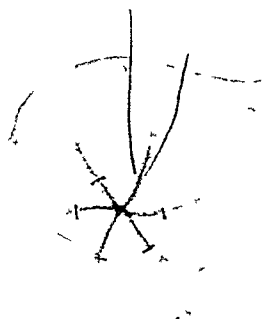


FIG. 157. Purse-string suture.

to occur because the suture cuts its way out, for it may not get a firm enough hold to keep the parts in apposition long enough for good union to occur. Therefore few surgeons now trust to this stitch alone, and most prefer to add a deep suture which pierces the whole thickness of the wall¹.

(2) *Halstead's Quilt or Mattress Suture* (Fig. 155) The distinguished surgeon who introduced this method claimed for it that—(i) It is so safe that a single row of it will suffice (ii) It constricts the tissues less than Lembert's sutures (iii) It tears out less readily if submitted to tension

(3) *Cushing's Continuous Stitch* is simpler more expeditious and buries itself better although it is not so firm as Halstead's interrupted suture when carelessly introduced it may act as a purse string The needle is passed in a direction at right angles to the axis of the bowel and picks up the serous and muscular coats (Fig. 156)

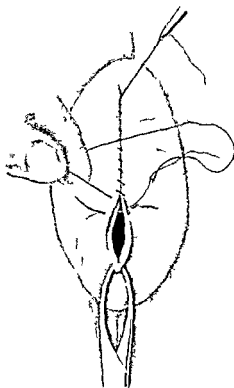


FIG. 158. Simple continuous purse string suture.
The tail thread and forceps hold up the ends
of the wound as the latter is sewn.

(4) *Purse string Suture* A small perforation is speedily and satisfactorily closed with a serous purse string suture The crushed stump of the appendix and tied ends of divided bowel are very quickly buried in the same way (see Fig. 157)

B. *Piercing Sutures* These pierce all the layers of the intestinal wall and thus secure a firm hold and arrest hæmorrhage In all of them the sutures are tied internally to prevent the leakage at the knot which is the commonest site of leakage in other methods (1) The simple suture piercing all the coats secures good apposition is speedily inserted and prevents hæmorrhage but it does not bury itself or secure good serous apposition (see Fig. 158) (2) Maunsell's suture being passed from the

mucosa through the inverted edges, maintains inversion and buries itself so that it is not visible on the serous surface (*see Figs. 152B and 160*).
 (3) Connell's stitch differs from that of Maunsell in that it does not pass

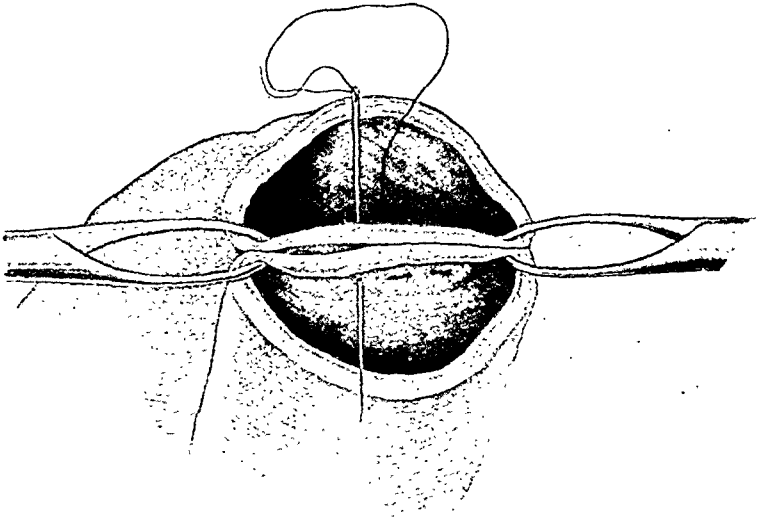


FIG. 159. Continuous mattress or piercing Connell suture, inverting the edges.

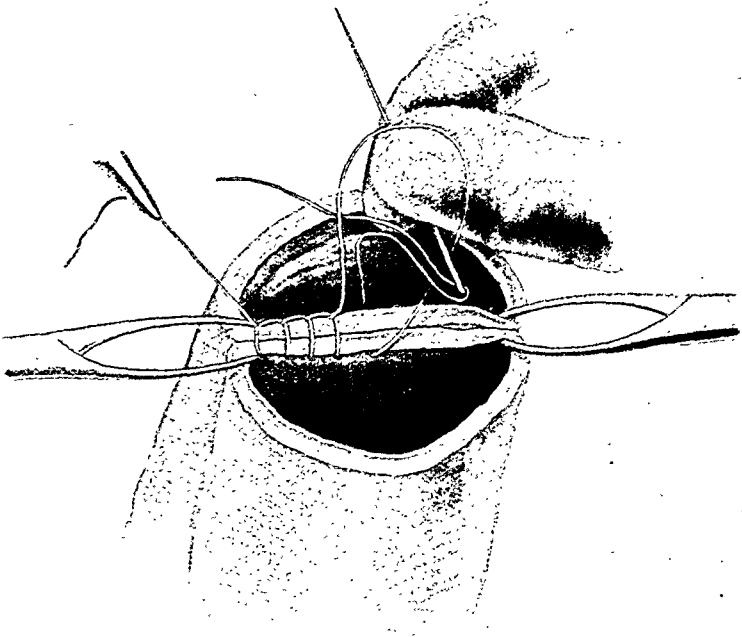


FIG. 160. The button-hole suture which prevents slipping and puckering.

over the edges of the wound but is a mattress one, which secures more inversion of the edges and is more hæmostatic ; it buries itself and maintains wide serous apposition so that an additional serous suture is superfluous

and may be mischievous by increasing inversion and valve formation. This valvulation and subsequent swelling may cause obstruction in the early days after the operation, especially in the small intestines of children, although it is true enough that the valve is not permanent. Connell's suture is neither so easy nor so accurate as the ordinary continuous running suture (see Fig. 159).

Continuous perforating sutures are the best for arresting hæmorrhage, and for this purpose the turns should not be more than one eighth of an inch apart.

The plan adopted by most British surgeons is to make use of a double line of suture, an inner continuous one taking up all the coats of the bowel, and an outer continuous sero muscular, both of fine linen thread or catgut. I use fine linen thread for the deep suture because it is stronger and more durable than catgut of similar size, reserving fine catgut for the serous suture because it is absorbable and need not be cast off into the lumen of the bowel.



CHAPTER XIII

SUBCUTANEOUS RUPTURE OF THE INTESTINE. GUNSHOT AND OTHER WOUNDS OF THE ABDOMEN AND OF THE DIAPHRAGM

SUBCUTANEOUS RUPTURE OF THE INTESTINE

CONTUSIONS, unlike bullet and other penetrating wounds, do not often cause multiple injuries of the bowel, but the individual lacerations of the intestine and mesentery are generally more severe ; for instance, the small intestine is sometimes completely divided. Therefore it is clear that the hope of recovery without operation is more remote, but the operation itself is likely to be less tedious and troublesome.

Cause. The bowel is most frequently ruptured by a wheel passing over the abdomen, by a squeeze or a crush, by a blow or a kick. It may be crushed against the spine or torn from its mesenteric attachments, especially at the junction of movable and fixed parts, such as the duodeno-jejunal junction. Sometimes the reduction of a strangulated hernia has led to rupture of the bowel. A man was admitted to Guy's Hospital recently who had ruptured his own intestine in this way. In the large majority of cases, as pointed out by Grant Massie,¹ the contusion is below the umbilicus. There may be, however, no sign of injury on the surface of the abdomen at first, but a bruise may appear some days later. Indirect violence,² such as a fall on the buttock, may rupture the bowel.

Site of Rupture. Out of 381 cases, published and unpublished, we³ have the following figures :—

Duodenum	..	..	..	..	23
Jejunum	..	..	..	..	157
Ileum	..	..	..	..	158
Colon	..	..	..	..	43

In one-tenth of the cases there was more than one rupture, sometimes the large as well as the small intestine being torn.

Nature of Damage. As a rule the laceration runs for less than an inch across the axis of the small intestine, but occasionally the latter is completely divided or severely bruised. The mucous membrane always pouts ; the bowel dilates above and below the rupture and rapidly becomes inflamed and œdematous. In about a fifth of the cases these lacerations of the bowel are multiple ; in nearly a tenth there are complications, such as rupture of the mesentery or of one or more of the other abdominal viscera ; in a quarter there is fracture of the spine or pelvis, and sometimes there are severe injuries to other parts, such as the chest and head. The frequency and severity of these complications contribute very largely to the mortality.

¹ *Lancet*, 1923, ii, 640.

² E. T. Senn, *Amer. Journ. Med. Sci.*, 1904, cxxvii, 966.

³ R. P. Rowlands, *Brit. Med. Journ.*, 1923, i, 716.

Symptoms and Signs There may be no evidence of internal injury at first which is most important to remember. The patient must be watched carefully for the following signs and symptoms —

(1) *Pain* is the most striking symptom. As a rule it comes on early and is very severe being described by patients as agonising.

(2) *Tenderness* This is at first local near the site of the injury but later it becomes general as a result of peritonitis.

(3) *Rigidity* At first this may be local but it soon becomes general. The abdomen may be flat at first or even retracted but later it becomes distended as a result of peritonitis with blood serous effusion and tympanites.

Pain tenderness and rigidity are the most reliable signs.

(4) *Shock* This is nearly always severe. It occurs and may even be fatal very soon after the accident. In some cases it passes comparatively quickly.

(5) *Vomiting* is almost always present often constant and most persistent.

(6) *Pulse and Temperature* The former is at first slow and weak from shock then normal and deceptive later increasingly rapid and weak as a result of peritonitis. Similarly the temperature is at first subnormal then normal and later raised.

(7) *Dulness* There is usually shifting dulness in the flanks as a result of blood and effusion. The liver dulness is often greatly diminished from free gas in the peritoneum.

(8) *Transmission of Heart and Breath Sounds* In a few cases with gas in the peritoneum the heart and breath sounds may be transmitted through the gas and fluid over the abdomen far beyond the natural limits.

(9) *Signs of Internal Haemorrhage* In many cases the patient is pale and restless as a result of hæmorrhage and examination of the blood confirms the evidence of this grave complication. The face is usually anxious pale cold and sweating and is in fact a typical abdominal facies.

(10) *Hamatemesis* often indicates injury to the stomach or small intestine high up.

(11) *Emphysema* of the abdominal wall or of the loin generally implies rupture of the bowel in its extra peritoneal part. When it affects the right loin the ascending colon or duodenum is ruptured on the left side the descending colon. Later on in such cases a faecal abscess may form in the loin.

As a rule the minds of these patients are unusually active and they often have a premonition of impending death.

Diagnosis. This depends a great deal upon an accurate history of a severe abdominal injury. Any one who has sustained such an injury should be kept under direct observation for a few days for although there may be no bad signs at first these may rapidly develop. It is of the gravest importance to admit such a case into hospital at once.

Severe pain tenderness rigidity and persistent vomiting following an abdominal injury should make us open the abdomen without delay although the pulse temperature and general condition of the patient may

be good. It is by operating in the early stages that the appalling mortality of these catastrophes can be reduced.

It is often difficult to distinguish this condition from rupture of the spleen, liver or mesentery, of which signs of internal hæmorrhage and shock are the most prominent. Diminution of the liver dulness and rapid onset of peritonitis are strong indications in favour of rupture of the bowel, but exact diagnosis is not so important as a realisation of the presence of grave intra-abdominal injury and the urgent need of an operation to set it right.

Treatment. Death is almost inevitable without early operation; therefore this should be carried out at the earliest possible moment, for the mortality increases with delay. The following figures, taken from 376 operation cases collected by Siegel, illustrate this point:—

Operation.					Mortality.
Within 4 hours	..	..	..	..	15·2 per cent.
„ 5 to 8 hours	..	..	..	..	44·4 „
„ 9 to 12 hours	..	..	..	..	63·6 „
Later	..	..	..	..	70 „

The mortality of this series was 51·6 per cent. and is very misleading, because fatalities are so often forgotten and not published.

Operation. While preparing for the operation every endeavour must be made to combat shock by warmth, saline or subcutaneous infusions or, in some cases, by transfusion of blood. Whenever possible, spinal anæsthesia, supplemented by gas or oxygen or by ether and oxygen, is chosen.

The abdomen is opened by a long incision near the middle line, preferably by displacement of the right rectus outwards. The jejunum, being the most likely part to be affected, is at once examined and the small intestine traced downwards to the cæcum. In many cases, however, the injured coil comes forwards into the wound directly the abdomen is opened, and gas and liquid escape. If no perforation is found in the jejunum or ileum, the duodenum is most carefully examined; in many cases lacerations of the duodenum have been overlooked at the time of the operation, and have only been found post mortem. Lastly, the cæcum and colon are examined.

Unless a loop of intestine has been very severely damaged, it is not necessary to resect. It is far safer to pare the edges of the laceration and to close it with two continuous sutures of fine linen thread. Linen thread closes wounds in these damaged tissues more effectively and permanently than fine catgut and does no harm. While the surgeon is closing the perforation, gauze rolls are passed into the pelvis and flanks to absorb the effusion in these areas. This is a quicker and better method than washing out, and the peritoneum is left dry and less damaged. In late and bad cases a stab wound is made about two inches above the pubis and a tube is inserted to drain the pelvis, but in most cases the peritoneum is completely closed.

Mortality. The mortality of this condition is appalling, and is chiefly due to delay and errors of diagnosis. Sir James Berry and Guiseppi¹ have done good service by collecting and analysing 132 cases of rupture of the intestine from contusion, from the records of ten London hospitals,

¹ *Lancet*, 1908, ii, 1143.

previous to 1908 Of Berry's collection 84 patients were operated upon with 67 deaths, a mortality of 80 per cent but in 15 the ruptures were not found at the operation, 7 of these were in the duodenum The Surgical Registrars of twelve London hospitals collected 44 cases occurring between 1908 and 1912¹ In 12 of these there was no operation Out of 32 operated upon 23 died (72 per cent) Taking these two series together, there were 176 cases with 116 operations and a mortality of 77 per cent It is interesting to note that 60 (or over one third) of the patients were not submitted to operation This was chiefly due to their grave condition on admission owing to delay or the presence of complications Grant Massie collected and studied the records of 31 cases at Guy's Hospital between the years 1899 and 1923, 31 of these patients were operated upon with a mortality of 78 per cent

It is certain that the best results are obtained by quick decision early operation and accurate and rapid work at the operation followed by careful after treatment

CASE I Mrs T H 43 years of age had been up to London and was walking from the station to her home at 4 p.m. on September 4 1922 She was carrying a heavy suit case, which had hard protected corners when she was run into from behind by a cyclist She was thrown violently forwards and doubled up over the case *one of the corners of which injured her in the right hypochondrium and the cyclist fell on top of her* She crawled to the side of the road in terrible agony and scarcely able to breathe or speak A doctor was fetched who however did not think anything very serious had occurred and he took her home (four miles) in a taxicab She almost fainted before entering the taxi but took some sal volatile which made her feel better She could not sit up or lean back and especially could not bear to be touched on the abdomen or trunk Arrived at home she crawled upstairs on her hands and feet holding her body rigid but shaking all over She was given a cup of tea but vomited at once Dr G J was called in late that night and found her with a rigid abdomen and very tender in the right flank Pulse and temperature were normal She was vomiting a little but brought up no blood A diagnosis was made of bruised ribs and abdominal wall As the pain was still very great he at the urgent request of the husband gave an injection of morphia ($\frac{1}{2}$ gr) but the following morning it was as bad as ever and as he was unhappy about the patient Dr G J got the writer to see her at noon Although the abdomen did not move well on respiration it was considered that there was not sufficient cause for an operation but by 8 p.m. she was much worse The pulse was 124 and temperature 102 the abdomen was getting more distended and she was very flushed the liver dulness had almost disappeared and the pain was so intense that the patient welcomed the idea of an anaesthetic as she longed for unconsciousness A diagnosis was made of ruptured viscus bowel or gall bladder and an operation advised and carried out at once *From the moment of the accident the patient had an acute fear of impending death and the brain was more than usually active throughout, in spite of the pain suffered*

Operation On opening the abdomen through the right rectus gas at once escaped, also foul, bile-stained pus of which there was a large amount in Morrison's pouch There was a large collection of thinner sero-pus in the pelvis This was mopped away and two rents large enough to admit the tip of the finger, were found in front of the junction of the first and second parts of the duodenum There was a narrow bridge between the two rents which was divided There was no induration of the duodenum nor any evidence of chronic ulceration Moreover the mucous membrane pouted which it never does from a perforated ulcer because it is adherent at the edge of the ulcer The large opening was then closed with fine linen thread in two layers the line of suture being transverse to the duodenum so that the lumen was not narrowed The omentum above and below the duodenum was then brought over the suture line A tube was left in a stab wound just above the pubis and another in the abdominal wall just above the wound

¹ Z Cope *Proc Roy Soc Med (Surg Sec)* 1914 vii, 86

The patient vomited a good deal during the next forty-eight hours, bringing up black vomit; the temperature kept up for a week, and there was considerable suppuration in the abdominal wall and some cystitis. She slowly regained strength, however, and made a complete recovery.

GUNSHOT AND OTHER WOUNDS OF THE ABDOMEN

The Great War revolutionised our ideas of military surgery of the abdomen. Whereas earlier experiences led us to believe that most gunshot wounds of the abdomen, inflicted under the difficult circumstances of war, were best treated conservatively, the European war conclusively proved that early operation offered almost the only chance of recovery from wounds of the hollow abdominal viscera; wounds of the solid organs are naturally less fatal. Evidence has accumulated that wounds of the bowel are practically always fatal under conservative treatment. For instance, of twenty-five patients known to have wounds of the intestine, treated conservatively and reaching the base alive, only four ultimately recovered, the remaining twenty-one dying of peritonitis.¹ In the past errors had crept in owing to many of the injuries which were thought to be penetrating really only affecting the abdominal wall, and in some of the recoveries the gunshot wounds were limited to the solid viscera: in still a third group the recoveries were false or only temporary, as already mentioned. Taking all wounds of the abdomen, the mortality under conservative treatment during the early part of the Great War was about 80 per cent. Under the circumstances of that war the patients suffering from abdominal wounds (which constitute between 1 and 2 per cent. of the total wounded) rarely reached the operating theatre, in spite of special efforts, earlier than six to ten hours from the time of receiving their wounds. In spite of this Sir Cuthbert Wallace² recorded 1,288 cases (965 of whom were well enough to be treated by laparotomy) with 46 per cent. recoveries. Thirty-five per cent. of those with wounds of the hollow viscera recovered. As a result of the special efforts made to deal with these cases a very large number of lives were saved, and most of these patients made complete recoveries, many being able to return to the fighting line.

The time factor is of the utmost importance. Up to six hours the chances are in favour of the patient, but after that period they are against him. After thirty-six hours there is very little hope of recovery after operation for wounds of the intestine or stomach. It will always happen, however, that a large proportion of men suffering from abdominal wounds will die, chiefly from hæmorrhage and shock, either on the field or before they reach the operating theatre. Many other cases are too bad for any operation when they arrive, having suffered severely from hæmorrhage, shock, pain and exposure. During an engagement the medical officers are often overworked, so that some delay is unavoidable in dealing with cases, even in hospitals especially devoted to this work. It is, therefore, of the greatest importance to make a careful selection of the patients likely to derive benefit from laparotomy, and this decision should be made as soon as possible—within an hour or two of the admission of the patient to the hospital. The most urgent cases are those in which there is evidence of progressive bleeding, usually concealed inside the abdomen. There is

¹ Sir George Makins, *Journ. R.A.M.C.*, January, 1916.

² *Brit. Journ. Surg.*, 1917, iv, 679.

nothing to be gained by waiting longer than an hour or two, for nearly all these patients get rapidly worse after this time. The time of waiting should be spent in reviving the patient by means of heat, water and saline infusions. As a rule they are already under morphia which has been humanely given during transit, for this diminishes shock.

Owen Richards,¹ in his able article on this subject, advises laparotomy whenever possible if the patient with a penetrating wound can be expected to leave the table alive. However, it is a mistake for the surgeon to waste time operating on hopeless abdominal cases, especially during an engagement, when his services are in urgent demand for more hopeful work. When the patient is blanched, cold, clammy and his pulse is over 130, there is very little hope from operation, nor is there much chance for patients admitted after twenty four hours. Wounds traversing the upper abdomen (especially on the right side), affecting as they usually do solid organs, are less urgent than those of the lower abdomen. It is very important to decide as soon as possible if the wound is penetrating or has opened the abdomen or not. In many cases this is very difficult for the entering and exit wounds may be placed almost anywhere in the body, depending on the position of the patient and the direction of the missile. Penetration may be indicated by prolapse of viscera, the escape of faeces, urine or bile, or far more commonly by the symptoms and signs already described under subcutaneous rupture of the intestine, but in many cases it is necessary to explore the wounds thoroughly in order to decide this important point. It is wise to operate in doubtful cases and safer "to look and see than to wait and see." Sometimes X ray examinations, when the missile is retained, help to give the direction of the wound and to decide the question of penetration. Nothing but exploration, however, will decide the nature and extent of the intra abdominal lesion.

Relative Frequency with which Different Abdominal Organs are Wounded From a total of 965 Cases²

Viscus	No of Wounds	Viscus	No of Wounds
Stomach	82	Spleen	54
Small gut	363	Kidney	73
Colon	252	Bladder	45
Liver	163	Pancreas	5

Preparation for Operation As a rule it is wise to pass a catheter to empty the bladder and this may also reveal blood in the urine. Intravenous infusion of normal saline plus 6 per cent gum solution is often necessary and, in some cases, transfusion of citrated blood is of great value. Direct transfusion of whole blood is generally best deferred until after the operation on account of the practical difficulties in military practice associated with the need of having the donor in the theatre, and the waste of personnel.

Whenever possible, either gas or oxygen or warm ether with oxygen is the best anæsthetic for these bad cases. Chloroform and C E mixtures are too depressing. Here rapid operating combined with gentleness, thoroughness and methodical work is priceless. No time must be

¹ *Surgery in War*, by A. J. Hull, 2nd ed., 306

² Sir Cuthbert Wallace, *loc. supra cit.*

wasted but, on the other hand, no laceration of the bowel must be missed. Therefore all the work must be systematic. First of all, the penetrating wound is explored and excised if necessary, that is, if it be soiled, lacerated or bruised. Then a separate right paramedian incision is made, about six or seven inches long, so as to avoid waste of time and the need of retraction, which bruises the tissues unnecessarily, and the character of issuing liquid or gas is noted. Wounds passing through one or other flank often pierce the ascending or descending colon and perhaps the kidney, spleen or liver : then a local wound is strongly indicated and may be oblique and parallel to the intercostal nerves. This wound gives good access to the damaged part and allows of excision and easy drainage of these highly infected wounds.

Large Intestine. If any fæces or fæcal smell is noticed the large bowel is the first part to be examined, the examination being made from the cæcum to the rectum. Any laceration of the large bowel is at once cleaned and sutured, for its contents are extremely infective. The mucous membrane of this bowel rarely pouts, but the site of laceration is indicated by bruising or bleeding. It is not always easy to examine the splenic flexure, the ascending or descending colon, or to close lacerations of these parts ; therefore it may be necessary to mobilise them by dividing the peritoneum in the bloodless area on the outer side. In some cases colostomy is necessary, and drainage of the soiled connective tissues of the loin is often imperative.

The Rectum. Lacerations of the rectum are difficult to close and require the Trendelenburg position and a long-handled needle-holder. In some cases the lacerations are very severe, and a cæcostomy, colostomy or short circuit may be necessary.

Small Intestine. The small intestine is then examined from below up. It is best to pass the bowel little by little in and out of the wound until the duodeno-jejunal flexure is reached, any lacerated part being retained outside and protected. It is not often wise to treat each injury or laceration as it is found ; it is best to ascertain the exact amount of damage before deciding on the most appropriate treatment, for in many cases lacerations may exist near a part so damaged that it must be resected, and a slight increase in the length of the bowel removed does not add to the shock, danger or disability of the operation. Moreover, two resections of the small bowel are very rarely successful. Resection is, however, to be avoided whenever possible by careful suturing of the wounds. In some cases the patient has recovered after the suture of as many as twenty lacerations. With care most of these can be closed without serious narrowing of the lumen of the bowel, the suture line being arranged transversely to the axis of the bowel whenever possible. Small perforations are best closed with simple purse-string sero-muscular sutures of fine black linen thread (No. 90), which is the best and most convenient material. Many small lacerations are well and rapidly closed without any fear of leakage by a single Connell suture which, of course, pierces all the layers of the bowel, turns in the edges and arrests hæmorrhage. Large lacerations, however, are often closed by the usual two layers of sutures, one piercing all the coats and the other the sero-muscular : to save time the same continuous thread may be used for both layers. In many cases it is necessary to excise the pouting mucous membrane.

Great care has to be taken with wounds at the mesenteric border the edges of the bowel being carefully inverted and the suture line covered with the neighbouring mesentery

Resection has been attended by more shock and on the whole in war surgery lateral anastomosis has been more successful than axial union

Mesentery Bleeding from the great omentum is rarely severe and can be stopped by ligature or if there is a large hæmatoma by excision. Bleeding from the mesentery is far more serious for it is difficult to arrest without compromising the blood supply of the bowel. Whenever possible the bleeding vessels are picked up and ligatured. In the presence of a large hæmatoma this may be very difficult or impossible. In many cases careful sewing of the rents is the most efficient method. Care is taken to invert the serous edges so as to prevent future trouble from adhesions. Severe wounds or injuries of the mesentery interfering with the circulation of one or more coils of intestine call for resection.

Stomach and Duodenum Wounds of the stomach are mostly anterior and small they give rise to much pain and curiously persistent vomiting with hæmatemesis. Sometimes they are very severe even dividing the stomach and causing furious bleeding. Thorough exploration and suture are advisable in every suspected case.

Wounds of the duodenum are very serious unless they are accurately closed and this is difficult especially when the wounds are retro peritoneal. Mobilisation of the duodenum is necessary in these cases.

Liver and Spleen Bullet wounds limited to the liver although they may cause severe hæmorrhage sepsis and secondary hæmorrhage do not usually call for operation for little can be done to arrest the bleeding which usually stops spontaneously. The fear of associated injuries of thoracic or abdominal hollow viscera however calls for operation. Larger wounds inflicted by shells call for exploration for the removal of the missile and pieces of clothing. Suture may sometimes arrest the hæmorrhage.

Wounds of the spleen are often associated with perforation of the colon stomach or kidney. Bleeding may be severe calling for suture or for complete or partial splenectomy. Simple perforations rarely bleed severely and are best left alone.

Pancreas Wounds of the pancreas are grave on account of injury to the large blood vessels in contact with it and above all from leakage and the destructive effects of the pancreatic juice with secondary infection. Free drainage is called for in these cases.

Kidney Wounds of the kidney often cause hæmaturia and in other cases traumatic aneurysm or large hæmatomata in the loin. Exploration through the usual oblique incision in the loin is the best treatment the wound being continued forwards and the peritoneum opened if necessary to examine and repair the intestines or other abdominal viscera. In severe injuries nephrectomy is necessary but as a rule free drainage suffices to prevent extravasation of urine and infection.

Lavage Irrigation of the abdomen is hardly ever any good. It is better to clean each damaged part by washing and sponging outside the body and then to leave the peritoneum dry having absorbed the effusion by means of gauze rolls the outer ends of which are carefully clipped to the towels. At the end of the operation the gauze is removed and the

abdomen is, as a rule, closed completely in layers. In bad cases only two layers are used, one of catgut for the peritoneum and the other of interrupted salmon gut sutures. For late cases, however, and especially those in which oozing continues in the peritoneum in spite of care, it is wise to drain the pelvis by means of a supra-pubic tube left in for thirty-six hours, for many deaths occurred in the Great War from suppurating hæmatoma in the pelvis. The parietal wound is very apt to suppurate from contamination with infected blood and other discharges during the operation, therefore it is wise to drain the parietes in many cases where peritoneal drainage is not required.

Mortality. In Sir Cuthbert Wallace's collection of cases the mortality of wounds of the various hollow viscera treated by operation was as follows :

	Per cent.
Stomach alone	52·7
Small intestine	65·9
Colon	58·7
Rectum	66
Bladder	56

Prognosis. Wounds of the central parts of the abdomen and especially those running from side to side, vertically or obliquely, across this area are very fatal because of the risk of multiple wounds of the small intestine. Antero-posterior wounds near the middle line above the navel are also very fatal as a result of hæmorrhage from the large vessels in this area. Antero-posterior wounds near the thick flanks of soldiers may fail to penetrate the abdomen and are generally less fatal than feared.

Wounds and Injuries of the Diaphragm. Wounds in this region are important, both in military and civil practice, owing to the important functions of the diaphragm and its intimate relations to the thoracic and upper abdominal viscera. Mr. Gordon Bryan¹ drew attention to this subject in his valuable Hunterian Lecture. Large wounds of the diaphragm embarrass the action of the heart and lungs and also frequently involve wounds of the thoracic and abdominal viscera, with liability to sepsis of both these cavities. Wounds of the right side of the diaphragm are less serious than those of the left because the liver protects the gap in the diaphragm and usually prevents diaphragmatic hernia, a common sequel of wounds of the left cupola.

In the early days of the Great War these wounds were treated conservatively with very poor results, comparing badly with those obtained later on, after the development of thoracic surgery. Bullet and other small wounds in the abdomino-thoracic region, on the right side, apart from severe hæmorrhage, are sometimes best left alone, for they chiefly involve the liver, but as a rule all abdomino-thoracic wounds should be excised and explored without delay. On admission into hospital these patients are generally so collapsed and cold that a little time has to be spent in resuscitation, but the operation is carried out as soon as possible, for the earlier this is done the more hope there is of preventing sepsis and hæmorrhage and of repairing the damage in time to save life. In a series of fifty consecutive serious cases operated on by Gordon Bryan,¹ twenty-

¹ *Brit. Journ. Surg.*, 1921, ix, 117.

six were evacuated to the base and twenty four died in the clearing stations

Symptoms Lockwood¹ showed that the symptoms of large wounds of the diaphragm resemble those of pneumothorax due to open wounds of the chest wall. These consist chiefly of shock, dyspnoea, disordered action of the heart with irregular and rapid pulse and thoracic respiration, with a catch at the end of inspiration. Later the signs of diaphragmatic hernia develop with partial collapse of the left lung and hydro-pneumo-thorax. A ray examination with or without the aid of a bismuth meal supplies valuable evidence in less acute cases. In the early stages

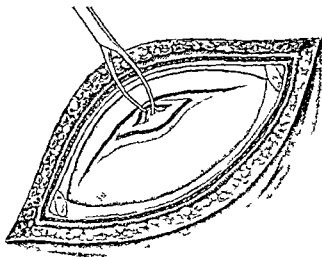


FIG. 161. Excision of a wound of the diaphragm which has been exposed by removing a rib. (After C. W. Cordon Bryan.)

there is rigidity and pain in the left hypochondrium and pain in the left shoulder as was first pointed out by Ambrose Pare. When the missile has entered the abdomen and wounded the intestines before entering the chest the dangers of septic infection are unusually grave.

Diagnosis Wounds of the diaphragm may be suspected from a careful study of the symptoms and observation of the track of the missile with or without the aid of radiography.

Operation Wounds of the diaphragm may be dealt with through—

(1) **An Abdominal Incision** With the aid of a good light and a fully curved needle on a long holder the gap can sometimes be closed from below but this may be very difficult and it has often been necessary to make an additional thoracic incision. In many cases however wounds of the diaphragm have not been suspected until the abdomen has been opened for abdominal injuries.

(2) **A Lower Thoracic Incision**, continued into the abdomen if necessary. As a rule this plan is the best, for it allows the excision of the infected

¹ *Brit. Med. Journ.* 1917, i, 319.

wound and repair of wounds of both the thoracic and abdominal viscera. Wounds of the lung, spleen, liver, kidney, stomach, colon, pancreas and small intestine have been successfully treated in this way.

Paravertebral anæsthesia (1 per cent. novocain) is invaluable in these cases, about 2 c.c. being injected just below the angle of each rib, as many as ten intercostal nerves being so anæsthetised in some cases. This may be supplemented, if necessary, by gas and oxygen or, failing this, by ether and oxygen. Oxygen is also very valuable in the after-treatment.

The parietal wound is excised through a long elliptical incision made parallel to one of the lower ribs, the missile or other foreign body (such as portions of clothing) are removed and wounds of the lung repaired. The

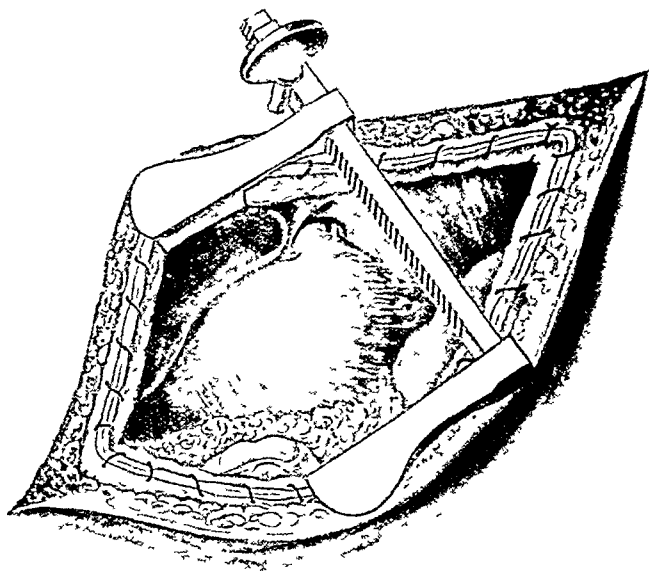


FIG. 162. Excision of a wound of the diaphragm with examination of the abdominal viscera from above. The pleura has been excluded by suturing the diaphragm to the intercostal muscles. The liver, stomach, spleen, omentum and splenic flexure of the colon are displayed. (After C. W. Gordon Bryan.)

pleura is cleaned and dried. Then an elliptical incision, about five inches long, is made round the wound in the diaphragm and the edges of this wound are sewn to the intercostal muscles to close the pleural cavity. Then the abdominal viscera are examined, the wound being carried down into the abdomen, if necessary, for the carrying out of any repairs. The wound is closed in layers.

When separate thoracic and abdominal wounds are associated opinions differ as to the best procedure, some surgeons believing that thoracic wounds should be dealt with first and *vice versa*. There is no doubt that closing wounds of the diaphragm improves the respiration and circulation, and this is a great advantage before proceeding to a laparotomy, which may take some time.

The following case, treated by Mr. Gordon Bryan, is a good example.—

Abdomino thoracic Wound of the Spleen and Stomach, with Prolapse of Omentum
Sergeant L A P, wounded 11 p.m., June 2, 1918, fragment of shell entering seventh interspace in mid axillary line, no vomiting. Admitted seven hours later. Pulse 108, left abdominal rigidity, catch in respiration, X rays showed missile related to left suprarenal body.

Operation, eight hours after injury. Gas oxygen, intercostal nerve-block, excision of wound and fractured eighth rib and cartilage (six inches), prolapsed omentum reduced, diaphragm wound excised, pleura cleansed and closed. Incision prolonged to abdominal wall, lacerated wound of greater curvature of stomach one inch from cardia sutured, through and through wound of spleen not bleeding, closed without drainage after careful examination of whole of posterior surface of stomach.

No shock or vomiting, small hæmothorax aspirated on fourth day. Tenth day, stitches removed, healed except for one stitch abscess of abdominal wall. Sent to base on thirteenth day. Wrote from England in August. "Fully recovered, no complications."

CHAPTER XIV

ENTEROTOMY. ENTEROSTOMY. COLOTOMY. COLOSTOMY. CÆCOSTOMY. APPENDI- COSTOMY

ENTEROTOMY

IN this operation the small intestine is incised for the removal of some abnormal or noxious contents, for instance, a foreign body accidentally or purposely swallowed, a fæcolith or a biliary calculus. Sometimes the poisonous contents of the intestine are removed during an operation for intestinal obstruction or peritonitis.

For the Removal of a Foreign Body. If possible the latter is backed into a healthy part of the bowel, and the coil of intestine containing it is brought out through a median incision and surrounded with gauze packs, emptied of fluid contents and clamped. A longitudinal incision of suitable length is made along the free border of the intestine, and the foreign body is removed. The pouch is cleaned with moist swabs, and the wound is closed with two continuous sutures of fine catgut. The knots of the deep piercing suture are tied within the lumen of the bowel. Sometimes it is necessary to make the suture line transverse to the axis of the bowel (*see* Figs. 154 to 156).

For emptying Fluid Contents. A coil a little way above the obstruction is chosen because its wall is healthier. This is packed off and, at the selected point near the free border of the distended coil, a purse-string sero-muscular suture is inserted. A trocar and cannula with rubber tube attached are inserted to conduct the gaseous and liquid contents well away from the operation table. The puncture is closed by tying the purse-string suture as the cannula is withdrawn. As an alternative, the distended coil of bowel is brought out and opened over a sterilised basin after the wound has been protected by moist pads; a transverse incision less than half an inch long is sufficient, and after the contents have escaped the incision is closed by two layers of fine catgut sutures, cleansed and returned into the abdomen. If this method does not overcome the distension it is better to perform valvular enterostomy than to pass a tube up the bowel for long distances with the object of emptying the latter at once—a procedure attended by considerable manipulation and avoidable shock.

ENTEROSTOMY

IN this operation an opening is made into the small intestine either (a) for feeding purposes, or (b) for temporary drainage in intestinal obstruction or paralytic distension.

(a) **Enterostomy for Feeding Purposes.** Here everything is done to prevent leakage of the irritating intestinal contents. It is clear that such an opening is of greater value the higher it is in the bowel. The duodenum

is so fixed as to be unavailable for the best type of valvular opening therefore the early part of the jejunum is nearly always selected

Jejunostomy Indications (i) Extensive carcinoma of the stomach where other operations are impossible (ii) Extensive carcinoma of the cardiac end of the stomach and œsophagus when gastrostomy is out of the question (iii) Extensive ulceration of the stomach invading the liver or

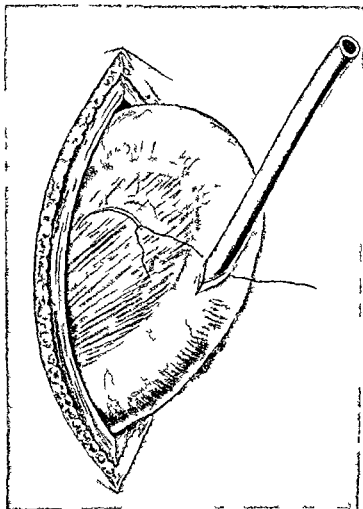


FIG 163 Jejunostomy after Witzel's method of gastrostomy first stage
The tube is fixed by a suture

pancreas unsuitable for excision Prolonged rest to the stomach has been very valuable in some of these cases (iv) Cases of simple general cicatricial contraction of the stomach the effect of swallowing caustic liquids It has been suggested also as a means of treating severe gastric or duodenal hæmorrhage by giving rest to the stomach and duodenum (v) It has also been suggested as a temporary measure for gastro jejunal ulcer and gastro jejuno-colic fistula when the patient's condition is too bad for a radical operation

Operation. The only operation that is worth describing is an adaptation of Witzel's method of gastrostomy.

The abdomen is opened through the upper part of the left rectus and the duodeno-jejunal flexure is sought. The transverse colon is drawn forwards with the left hand, while the right forefinger passes backwards and to the left along the under surface of the mesocolon

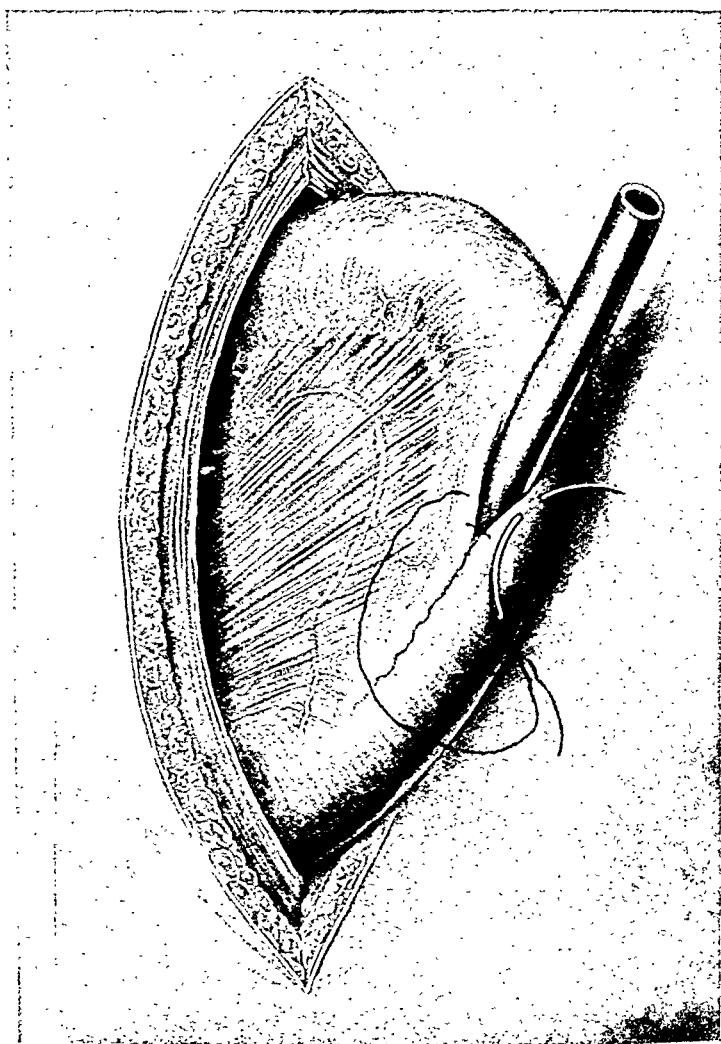


FIG. 164. Jejunostomy after Witzel's method of gastrostomy, second stage. The Cushing suture is introduced.

Until this operation the jejunum at its origin, just to the left of the spine, and (H/a) for feeding purposes. The peritoneal ligament joining the flexure to the obstruction or perforated. The jejunum is then traced down for about eight inch (a) Enterostomy is brought out of the abdomen and packed off.

A vent leakage of lining is made into the intestine near the distal extremity of the opening is of great and on the side opposite to the mesentery. A rubber size of a No. 12 catheter is inserted and fixed by a single

catgut stitch which includes the cut edge of the bowel and the side of the tube. The tube is laid upon the ante-mesenteric border (towards the origin of the jejunum) and buried by means of a continuous suture (see Figs 164 and 165). The tube should be buried for about two inches and the suture should extend well below the opening into the intestine. The tube is brought forwards through a small opening in the great omentum

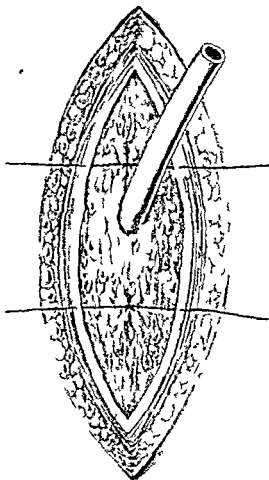


FIG 165 Jejunostomy. The tube is brought out through the omentum which helps to prevent leakage.

so that the latter adheres to and protects the opening in the bowel, preserves the mobility of the loop and facilitates the subsequent closure of the fistula when the tube is left out. The intestine is fixed to the parietal peritoneum and the wound closed around the tube which is left long. A funnel may be inserted in the end of the tube for feeding purposes. At first only about six to ten ounces of milk are given slowly every three hours. Later the meals are increased in size and quality so that the patient rapidly gains weight.

(b) **For Temporary Drainage.** When the bowel is considerably damaged and paralysed and the patient is very ill, it is sometimes necessary to drain it for a few days to enable it to recover its natural condition. Whenever possible, the cause of the obstruction is removed before the abdomen is closed, but in some cases this has to be deferred until the condition of the patient has improved sufficiently. When the cause of obstruction has been overcome the tube should be removed when vomiting has ceased for two days and the enterostomy allowed to close spontaneously. In rare cases it may be necessary to close it under

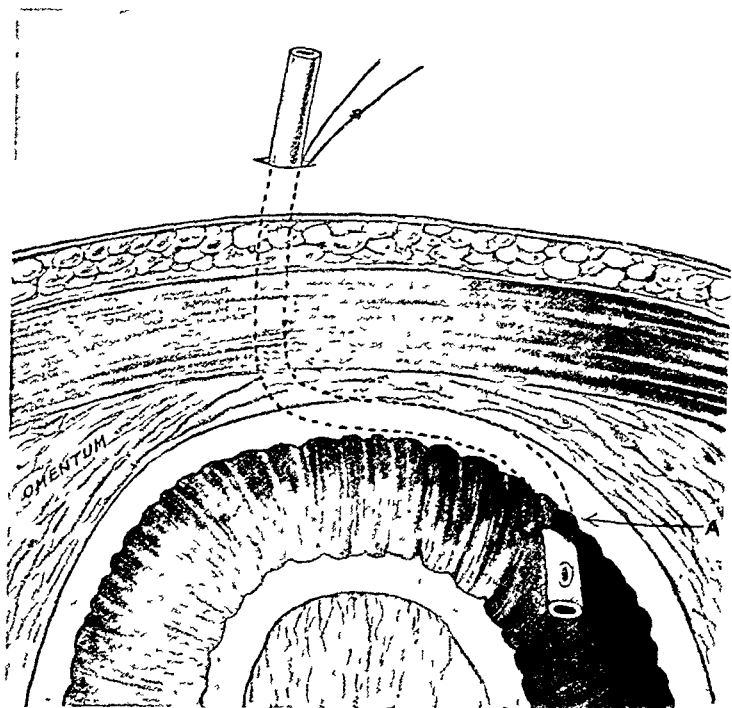


FIG 166 Enterostomy for drainage. The slip knot on the suture holding the tube in the bowel can be undone and the tube removed at any time.

local or general anæsthesia. When the cause of obstruction has not been removed at the primary operation, the enterostomy cannot be closed until the obstruction is removed. When the obstruction is irremovable an enterostomy should not be performed, for a permanent artificial anus in the small intestine is intolerable. The higher it is the more intolerable, for much of the food is wasted and the patient gets thin and also miserable from irritation of the skin. In these cases it is far better to make an anastomosis between the bowel above and below the obstruction and, if necessary, to make a valvular enterostomy above the anastomosis.

Operation. The selected coil is withdrawn, emptied, packed and clamped off, while a valvular enterostomy is performed as described under jejunostomy except that the suture fixing the rubber tube in the bowel is tied into a slip knot, the ends of which are left long and brought out of the wound with the tube. In this way the knot can be untied and the tube removed at any time when it has served its purpose. When extensive

peritoneal adhesions and distension of the bowel make the Witzel technic impracticable the tube may be fixed in either by a purse string or a couple of Connell sutures which invert the edges of the intestinal wound thus imitating a safety ink bottle. As a rule the higher up in the small intestine the more effective the enterostomy. The bowel can be irrigated at any time through the tube (Fig 166)

Victor Bonney¹ pointed out the great value of jejunostomy in cases of intestinal obstruction and paralytic ileus, but he did not make a valvular spontaneously closing opening. D. P. Wilkie² has used a rubber tube to conduct the contents of the bowel above the obstruction to that below, the greater part of the middle of the tube with glass insertion lying outside the body.

COLOTOMY

Occasionally the colon is incised for the relief of great distension, mostly gaseous, during operations for intestinal obstruction *e.g.*, a volvulus of the sigmoid colon may be irreducible until the enormous distension is relieved. As a rule it is sufficient to puncture the distended bowel with a small trocar and cannula or even a large cutting needle, when the gas at once escapes. The puncture is made at or near a longitudinal band and within the circle of a purse string sero muscular suture, which is tied as the cannula is withdrawn.

Sometimes a free incision is necessary for the removal of a foreign body, gall stone or hard faecolith, which cannot be removed in any other way. The incision is made through and along a longitudinal band. Whenever possible, the loop of bowel is first withdrawn, packed off and clamped. The wound is closed with two continuous Connell and Cushing sutures of fine linen thread and one or more of the appendices epiploicae are tacked over the suture line.

COLOSTOMY

In this operation an artificial anus either temporary or permanent, is made at a convenient site in the colon. It is often urgently necessary for the relief of complete obstruction of the rectum or colon, is sometimes a necessary preliminary to resection of growths of the rectum or colon, and often a permanent measure for the relief of symptoms due to irremovable growths or disease of the rectum or pelvic colon. Often it is the price paid for the prolongation of life or cure afforded by excision of the rectum for cancer. The type of operation naturally varies with the nature, urgency and permanency of the need.

Before describing and comparing the different modes of performing colostomy I shall deal with those conditions which call for this procedure, then the advantages of the chief methods and the cases to which they are relatively adapted, describing finally the operations themselves.

Indications for Colostomy. (1) *Certain cases of malignant disease of the rectum.* (i) where obstruction is present, impending or threatening, (ii) where, in cases which are too advanced for excision, there is extensive ulceration, great pain, difficult defaecation, loss of sphincter power,

¹ On Post operative Paralytic Obstruction of the Intestine with special reference to its Treatment by Jejunostomy, *Archives of the Middlesex Hospital* xxi, 29

² *Brit Journ Surg*, 1924 xi 558

profuse blood-stained or fæco-purulent discharge from the bowel or multiple fistulæ, especially recto-vesical fistula, the operation is abundantly justified. Mr. Ernest Miles¹ advises early colostomy in every case of carcinoma of the rectum which is not removable, because it prolongs life and makes it more comfortable, enables the patient to eat full diet and prevents complications such as suppuration with the formation of fistulæ in the perineum.

As a rule, the more complete the failure of previous treatment, the more painful, difficult, frequent and unsatisfactory the action of the bowels, the greater the tendency to distension of the sigmoid or lower intestines generally, the more frequent the attacks of gripings and partial obstructions which herald in the tormina of a complete *miserere*, the younger the patient, and thus the longer the natural prospect of active life, the more plain are the indications for colostomy. On the one hand, certain special evils call loudly for the relief which the operation may give, viz., a patulous or invaded sphincter allowing of involuntary escape of flatus and fæces; multiple fistulæ giving rise to foul sanious discharge, keeping the patient (perhaps a woman of scrupulous cleanliness) in a constantly filthy condition, and leading to a brawny, painful condition of the buttocks, which thus readily become the seat of cellulitis and its allies; projection of the growth downwards through the anus, leading not only to a patulous sphincter, and its consequent wretchedness, but also to irksome or painful sitting. On the other hand, certain conditions contra-indicate the operation, viz., exhaustion of strength, evidence of secondary deposits in the peritoneal cavity or liver, extension to the inguinal glands and absence of much pain or obstruction from first to last.

It has been too much taken for granted, because rectal cancer is often a disease of much suffering and because, from the inefficiency or neglect of treatment, obstruction does occur, that when cancer of the rectum is diagnosed, the patient has therefore agonising pain and obstruction to look forward to. The above view is quite incorrect. In a few cases cancer of the large intestine may run its course and set up visceral deposits and kill the patient with very little pain, and no threatening of obstruction² whatever.

Other very important points, on which the patient or the friends, especially if in a better rank of life, will frequently expect a decided answer, are the amount of relief, and also the amount of annoyance, which will follow the formation of an artificial anus.

The amount of relief given will depend on the amount of pain the patient has, the degree to which obstruction is threatening or the presence of special miseries such as those alluded to above. Patients may be assured that any continuous pain will be greatly lessened in severity, if not entirely removed; that defæcation will become easy, painless and, after the first four or six weeks, limited to about one motion a day; and that the distress of constant desire to go to stool, tenesmus and bleeding will diminish.³

¹ *Cancer of the Rectum* (Harrison & Sons, London), 1926, p. 68.

² In a few cases the growth may, instead of projecting into and obstructing the lumen of the bowel, have led by ulceration to enlargement of the gut into a cavern-like space.

³ I.e., if the opening is free, if there be a good "spur," and no fæces find their way into the bowel below, but discharges from the growth may cause tenesmus.

The other part of the question—the amount of annoyance following on an artificial anus—must be honestly met. There is too great a tendency amongst writers on colostomy to teach that if the operation is done sufficiently early the patient's condition is *always* a most satisfactory one. While it is always right to remember that the disease is a mortal one and that if a fair comparison is to be made it must be not between the condition with an artificial anus and that of perfect health but between an artificial anus and a bowel with incurable cancer the patient's after condition will be materially affected by his position in life. Where a patient's remaining days are easy where he can continue to be careful in his food to avoid diarrhoea where he can pay regular attention to the opening this may give little annoyance and it is also a rule that the greater the miseries of pain and frequent and difficult defecation from which the patient has been relieved by colostomy the more easily does he forget any annoyance of the anus in his relief at what he has escaped from in the past. But on the other hand where the surroundings of the patient compel him to try to work the friction of any prolapsed bowel which follows on movements of the thigh and groin the difficulty of paying attention to the opening of avoiding diarrhoea from unsuitable food of washing out the lower bowel—all these may mean that colostomy has only enabled the patient to exchange a life of miseries for one of annoyances—the miseries of the disease for the annoyances of the opening annoyances certainly less important but not the less present to the patient because they were unexpected. In the large majority of cases, however the results of a well performed colostomy with proper spur formation are very good and the patient is satisfied.

Incomplete relief may be due to persistent passage of motions over the malignant disease and teasing diarrhoea from the artificial and natural anus which in turn appear to be caused by—(a) an inefficient spur (b) persistence of the growth in the bowel below causing a profuse sanious discharge (c) the growth extending upwards towards the wound or the bowel having been opened only just above the growth.

The question of the value (or otherwise) of colostomy as a preliminary to excision of the rectum will be discussed later.

(2) Temporary colostomy is sometimes advisable in some cases of late volvulus of the sigmoid with paralytic distension.

(3) Fibrous stricture of rectum or pelvic colon in which previous treatment including dilatation has failed and for which proctotomy is not suitable or resection is considered too dangerous.¹

(4) Pelvic tumours—e.g. enchondroma or sarcoma—pressing on the rectum.

(5) Results of pelvic cellulitis narrowing the rectum.

(6) Vesico-intestinal fistula.

Colostomy is performed in some cases of communication between the large intestine especially the rectum and the bladder to prevent the passage of feces into the bladder with its results of cystitis agonising obstruction of urine and passage of flatus from the urethra without notice and beyond control.

Such a fistula is much more frequently met with between the pelvic colon or rectum and the bladder if between the latter and the rectum the

¹ Prof H. Hartmann and others *Med Soc Trans (London)* 1923 xlv 191

communication may be found by the finger, or by passing a duck-bill speculum, or by the aid of the sigmoidoscope and injecting coloured water into the bladder. Sometimes malignant in character, it is more frequently of a simpler nature—*e.g.*, due to pericolitis, especially that secondary to diverticulitis of the sigmoid—and so, perhaps, curable. Thus, in Mr. Holmes's case,¹ the ulceration between the sigmoid and the bladder was not malignant, colostomy for fifteen months was most successful, but a permanent cure was prevented by similar ulceration taking place between the cæcum and bladder, which caused death. Whether the cause is malignant disease or no, the life which lies before the patient is scarcely tolerable.

The opening is frequently valvular in nature—*i.e.*, while it admits of the passage of fæces into the bladder, urine very rarely passes per anum. In most cases a secondary radical operation is indicated for non-malignant fistula, the disease of the bowel and the opening into the bladder being treated by abdominal section.

(7) *Imperforate Rectum.* Colostomy (iliac) is usually performed on the left side in cases of malformation of the rectum, when this part of the intestine cannot be found by a dissection in the perineum. It used to be disputed in these cases whether, after an unsuccessful exploration in the perineum, an iliac or a lumbar colostomy should be performed. The great majority of surgeons have preferred the former operation, following Mr. Curling.² An anterior incision allows a thorough exploration to be made; three cases have come under my notice in which the whole of the large intestine was represented by a fibrous cord with a very minute central canal, and the ileum had to be opened.

(8) Tuberculous disease of the rectum if extensive occasionally demands a temporary colostomy; the rest so obtained may be of great value, and the artificial anus may be closed later in some cases.

(9) Malignant disease of the colon. Permanent colostomy may have to be performed for intestinal obstruction, due to this disease affecting the pelvic colon too late for removal and too low down for a short-circuit to be performed with safety and efficiency.

(10) Severe membranous colitis and ulcerative colitis. Mr. Golding-Bird and Sir William Hale White have described three cases of membranous colitis in which right lumbar colostomy was performed, and one case of chronic dysentery in which cæcostomy was employed.³ They have also given the more valuable subsequent histories of these cases.⁴

Messrs. Keith and Simpson⁵ publish an account of right colostomy performed in June, 1894, on a woman æt. 34, with four years' history of membranous colitis. The wound was kept open for seven months and then closed. A perfect cure is recorded.

Curl mentions several cases of moderately severe dysentery treated by cæcostomy with hopeful result.⁶

It may be concluded from these cases and others, that right colostomy is beneficial in the treatment of severe chronic colitis, especially ulcerative

¹ *Med. Chir. Trans.*, xlix and l.

² *Diseases of the Rectum*, 228.

³ *Clin. Soc. Trans.*, 1896, xxix, 45, and *ibid.*, 1899, xxxii, 183.

⁴ *Ibid.*, 1902, xxxv, 164.

⁵ *Med. Press.*, July 24, 1896 (quoted *Clin. Soc. Trans.*, 1899, xxxii, 187).

⁶ *Ann. of Surg.*, 1906, xliii, 543.

colitis and that the operation is better than cæcostomy because the diseased colon is granted a more complete rest the discharges are more solid and less frequent owing to the absorption of fluid in the cæcum. The skin around the fistula is less apt to get inflamed. The absorption of water and some nourishment in the cæcum is a distinct gain in feeble patients. Mr Golding Bird believed that complete rest to the colon is more valuable than irrigation. The time of closure must not be too early, certainly not under a year in most cases otherwise relapse may take place. A right sided colic or cæcal artificial anus or even a fæcal fistula there is a great nuisance and is so difficult to close that it must not be made lightly. When an artificial anus is made in the cæcum or ascending colon strictures and general withering and narrowing of the inflamed colon are very apt to occur making it increasingly difficult or impossible to re-establish the natural channel later on. In most cases when medical treatment has failed it is best to explore the abdomen thoroughly in the hope of finding and removing the cause of the colitis and being rewarded by an immediate cure in most cases of mucous colitis due to chronic appendicitis or pericolicitis with adhesions and bands.

Mr Golding Bird considered that colostomy is preferable to ileo sigmoidostomy in these cases for several reasons the anastomosis may not be below the disease which may extend to the pelvic colon in some cases and the feces in time regurgitate into the diseased colon above and set up more trouble. Other alternatives of treatment are valvular cæcostomy and appendicostomy with irrigation which are discussed later on (see p 257) and colectomy.

LEFT INGUINAL OR ILIAC COLOSTOMY

This operation has replaced lumbar colostomy because the iliac operation has the following advantages (i) It is easier. Thus (a) the patient being on his back takes the anæsthetic better than when rolled on his side. (b) in a stout patient especially the soft parts are easier to divide and the resulting wound less deep and more readily dealt with than one in the loin. (c) the bowel is more easily reached and with less disturbance of deep lying soft parts. (d) there is no risk of opening small intestine or of failing through abnormality of the colon. (ii) The peritoneum being opened of set purpose the surgeon can explore the abdomen and examine the site and extent of the disease. (iii) The shallower wound makes it much easier to draw out the intestine and make a satisfactory angle and spur. (iv) The position of the anus renders it more easily accessible for the needful attention.

Operation. An incision two inches long is made with its centre at the middle of the line joining the left anterior superior spine and the umbilicus.¹ There are three points here of the greatest importance from their bearing on the chief drawback of this operation prolapsus. Mr Cripps² found that by making his opening in the abdominal wall some what higher than in his earlier cases there was much less tendency to

¹ If the navel is placed lower and further out the colostomy cup does not fit well but comes in contact with the iliac crest. Mr Lockhart Mummery makes his incision just below the umbilicus and three quarters of an inch internal to the outer border of the left rectus.

² Complications arising in Inguinal Colostomy. *Brit Med Journ* October 19 1890.

protrusion. Moreover, a high incision allows the transverse colon to be used for the colostomy if necessary. Another point to be insisted on is that, wherever the opening is made, it should be as small as possible. The freer the incision, the weaker the abdominal wall—already naturally weak here—and the more certain is a large prolapsus to follow. In an ordinary case of iliac colostomy for rectal cancer, the operator should endeavour to find the sigmoid with an opening admitting two fingers to explore deeply, if need be as far as the pelvic brim, and hook up the sigmoid. Lastly, it is an advantage to use the “gridiron” or valvular incision similar to that which McBurney introduced for the removal of the appendix. The risk of prolapse is much diminished, and the control obtained over the artificial anus is greater. Carwardine¹ cuts across the fibres of the external oblique aponeurosis, making his skin incision also in the direction of the muscular fibres of the internal oblique and transversalis. He states that he thus avoids the contraction of the orifice that is liable to occur if the tendinous fibres are merely separated. When the incision is placed as high as advised above, the tendinous fibres of the external oblique are not seen. More œdema of the prolapsed loop is apt to occur when muscular separation is adopted instead of division of the muscular fibres, but this soon passes off. Some surgeons believe more control is obtained by making the incision through the outer third of the left rectus, the muscular fibres of which are separated. Mr. Ernest Miles makes a median laparotomy to explore and mobilise the pelvic colon which is then brought through a small stab wound in the left iliac region. The layers of the abdominal wall having been separated and all hæmorrhage arrested, the peritoneum is then raised, and slit up with scissors. The sigmoid, the omentum or small intestine may be seen in the wound. If either of the two latter present (and the omentum may do so very persistently), they are returned, and the colon is sought for with the finger. It is usually close at hand and may be recognised by the scybala which it contains, or by its appendices epiploicæ and longitudinal muscular bands which are not always obvious, however. The transverse colon may be very low, but it is distinguished by the attachment of the great omentum to it. In difficult cases the bowel will be found by searching in the iliac fossa, the finger being passed along the parietal peritoneum from without inwards, until the sigmoid is encountered attached to the posterior wall; this is the best method. Failing this, the descending colon may be traced down from the kidney. It is well to remember that anterior colostomy is not always the easy operation, as regards finding the bowel, that it is represented to be. Mr. Cripps² spoke of occasionally having had great difficulty in finding the bowel.

In one case, after a long search, he was unable to find the bowel; the nurse being directed to give an injection of water, the finger near the brim of the pelvis then felt a piece of intestine, which had before been overlooked, becoming distended, and the sigmoid, which was lying almost over in the right iliac region, was thus detected.

In a case of Mr. Cooper reported by Dr. Pennington, of Chicago,³ the operator having failed to find the sigmoid, water was injected into the rectum, and was noticed

¹ *Pract.*, 1905, lxxiv, 179.

² *Loc. supra cit.*

³ *Journ. Amer. Med. Assoc.*, 1893, ii, 773.

to pass into the right iliac fossa. The opening in the left side being closed, an incision was made in the right inguinal region where the gut—presumably the misplaced sigmoid—was readily found. The patient made a good recovery.

In some cases the wound may have to be enlarged by prolonging the separation of the two deep muscles inward, opening the rectus sheath and drawing the rectus inwards, then the large intestine may be traced upwards from the rectum if necessary.

The bowel being found, a loop of it is drawn up into the wound. To avoid the prolapse which is certain to occur if loose folds of the sigmoid remain immediately above the opening, the surgeon gently draws out as much loose bowel as will readily come, passing it in again at the lower

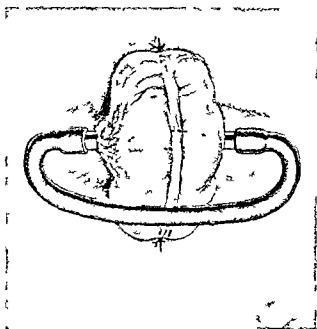


FIG 167 Colostomy through outer third of left rectus. Glass rod used to keep the loop of colon in position. Later a transverse incision is made into the colon.

angle as it is drawn out from above. In this way after an amount varying from one to several inches has been passed through the fingers, no more will come. As soon as the descending colon is found in this way to be nearly taut, a pair of forceps is pushed through the mesosigmoid about a quarter of an inch from its attachment to the bowel, and a glass rod is drawn through to hold the bowel up; a piece of rubber tubing is pushed over each end of the rod to keep the latter in place. A mattress suture passing through the mesocolon and the whole thickness of the abdominal wall on either side of the wound serves equally well and is often more convenient. The angles of the wound are closed with sutures so that the skin fits snugly round the small loop of colon, and the end of the sutures can be tied round the bases of appendices epiploicæ, most of which are excised. The wound is dressed with vaselined gauze and

sterile pads arranged all around the bowel so that the latter is in a kind of box and is not liable to be damaged by the firm pressure that must be maintained to prevent protrusion of more bowel through the wound during vomiting. This danger can be avoided by applying a broad band of strapping firmly all round the body outside the dressings (Davies-Colley). The bowel may be opened with scissors by a small transverse incision on the second or third day.¹ No anæsthetic is required, for the

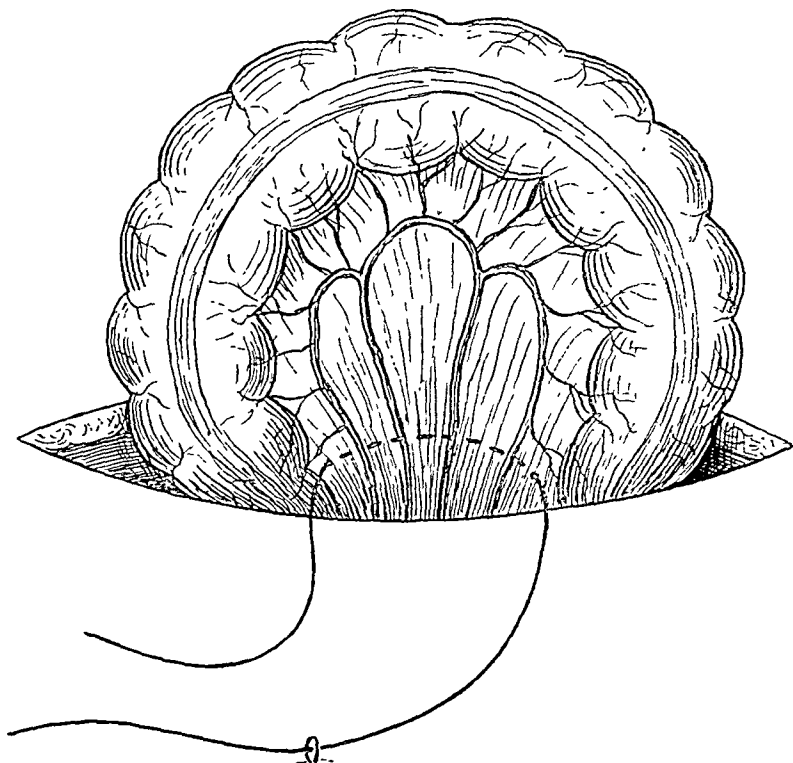


FIG. 168. Colostomy (W. E. Miles) showing the method of creating an efficient spur. A stout silk ligature is looped round the vessels of the mesocolon and, having been passed through a loop of silkworm gut fixed in the skin midway between the inner margin of the wound and the umbilicus, is tied sufficiently tight to impede the venous return but not to occlude the arteries.

bowel is insensitive. The opening may be made with the cautery to avoid bleeding. Ten days later the glass rod is removed and nearly all the bowel that projects above the skin is cut away with scissors; all bleeding points are tied or secured with under-running sutures.

When the projecting loop has been pared down and the bowel completely divided as advised above, two openings will be seen separated by an efficient spur. Through the lower of these the rectum can be washed out, and the removal of any faeces lying above the disease facilitated. As a rule aperients are to be avoided, but the patient is encouraged to endeavour to get an action of the bowels every morning, preferably after

¹ Vomiting and distension of the abdomen are indications for opening the bowel earlier; it is safe to do so if necessary after twelve hours.

breakfast, when the weight of food in the stomach stimulates the transverse colon. Foods and drinks which cause diarrhoea are to be avoided. Gradually, usually in about a month the patients begin to acquire some control over their artificial opening, but it will not be till several months after the operation that they can be said to become comfortable in this respect, and acquire satisfactory control over and management of their artificial anus. And for the rest of their life discharge of blood and slime may occur from the anus. This must be met by astringent injections and suppositories. Diarrhoea must be treated by strict attention to diet and by astringents, escape of offensive flatus or faeces from the artificial anus may be met by the use of charcoal a teaspoonful being given twice

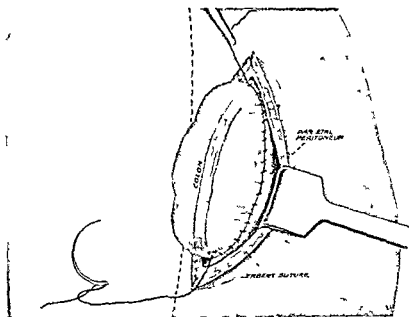


FIG 169. Inguinal colostomy. Paul's method of sewing a lateral pouch of the iliac colon in the wound which is from $1\frac{1}{2}$ to 2 inches long and is external to the rectus.

a day, or the following may be taken twice a day in a capsule or cachet, viz, betol, salol, salicylate of bismuth of each gr \times 1.

Mr Paul² did not wish to make a spur and did not bring so much of the bowel out, but fixed it to the parietal peritoneum with a continuous sero-muscular suture of catgut (Fig 169). He clamped the projecting pouch, opened it at once and sewed it to the skin with a continuous button hole suture of catgut (see Fig 170).

Where complete obstruction is present, the bowels much distended and the sigmoid requires immediate opening additional care must be taken in handling the intestines and in preventing any escape of faecal fluid or gas into the peritoneal cavity. Aseptic gauze is wrapped round the base of the loop of bowel and under any supporting rod, protecting the line of suture and peritoneum.

¹ Mr C Heath, *Brit Med Journ*, 1892, i, 1243

² *Lancet* 1912, ii, 222

A portion of the bowel is emptied and gently clamped, while a small rubber or Paul's glass tube is introduced without contaminating the wound (see Figs. 171 and 172).

The objection which has been raised to the method, namely, that sloughing and loosening of the tube take place too rapidly, may be met by using a small rubber tube and by fixing it with a purse-string suture piercing all the coats close to the edge of the incision in the bowel.

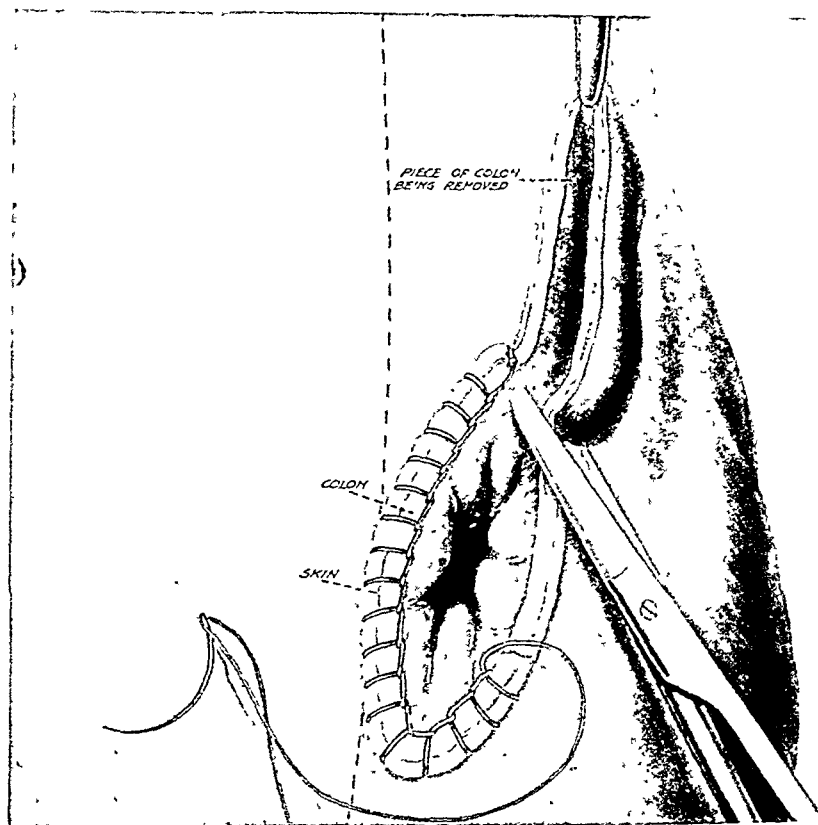


FIG. 170. Inguinal colostomy. Paul's method of immediately opening the colon and sewing the edges to the skin. The opening is only 1 to 1½ inches in diameter.

Greig Smith's method of fixing a long rubber tube in the intestine is very simple and nearly always practicable. Two side holes are made near its end which should be passed into the distended colon within the abdomen, so as to ensure good drainage.

Madelung's modification of colostomy consists in division of the colon with closure of the lower end, which is dropped into the peritoneal cavity. It has not found much favour in this country because it is more dangerous than the simpler operation. The passage of fæces into the lower part of the bowel can be prevented by simpler and safer means. Sometimes, the colon being twisted, the wrong end has been closed and dropped in, with disastrous consequences.

Mr. H. Allingham stated¹ that in seven of his inguinal colostomies the gut must have been thus "twisted," as fæces came away through the

¹ *Brit. Med. Journ.*, 1891, ii, 337.

lower of the two openings. He stated that he knew of fatal terminations from this cause in several cases in which Madelung's operation had been adopted.

Hartwell,¹ in performing colostomy as a preliminary to excision of

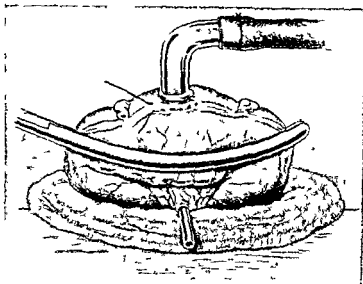


FIG. 171 Inguinal colostomy. The parietal wound is protected by gauze wrapped round the loop of bowel beneath the rod. The colon is clamped while a Paul's tube is inserted and firmly secured with a purse string suture piercing all the coats.

the rectum brings the sigmoid into the wound through a gridiron incision at the level of the left anterior superior spine, he divides the clamped bowel across at a distance of about twelve inches from the anus. The distal end is then fixed at the lower angle of the wound. The proximal

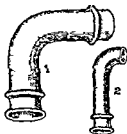


FIG. 172 Paul's glass tubes, large and small. The lower end is tied in the upper receives the drainage tube.

end is protected by gauze and drawn upwards and inwards between the rectus muscle and its anterior sheath and secured in a small vertical incision near the middle line. Care is taken not to damage the vessels of the meso sigmoid during this manoeuvre, the mesentery is only slit

¹ *Ann of Surg*, 1900 xli, 273

enough to allow the intestine to come into the median wound without tension. Hartwell claims that this method gives the patient more control than any other. It seems to me unnecessarily severe, and, moreover, it is not practicable without gravely increasing the risk where the sigmoid is distended and friable in obstructive cases.

Marro¹ sterilises the open end of the colon and passes it through a subcutaneous tunnel over the rectus muscle, where it can be compressed by a belt. Sir Berkeley Moynihan² sometimes uses a similar method.

Lilienthal³ twists the end of the bowel and thus tries to create a valvular opening.

If the artificial anus contract unduly, it must be dilated with conical bougies. Mr. Cripps has introduced a spring dilator which is self-retaining and which can be worn for four or five hours daily. That this complication is one to be watched for is plain from this passage in Mr. Cripps's experience:⁴ "This is not an uncommon sequence, and, if allowed, will destroy the whole advantage of the operation. Too small an opening means a constant dribbling of faecal matter, the motions never getting freely and completely away. These contractions do not occur where the original opening has been made of proper size, and where all the wound has healed by first intention, but occur where the angles of the wound have failed primarily to unite, and where the granulations gradually become converted into firm contractile tissue. If the angles have not united properly, the contraction will begin about the third week; and if at this time a little spring dilator be introduced and worn for a few hours daily for a month, the tendency to undue contraction will be obviated. If this precaution has been neglected, or be impracticable, the opening can readily be made the right size by passing the finger into the bowel, and then completely cutting through all the contractile tissue up to each angle, the depth of the cut exposing the wall of the bowel. The bowel is now freed a little on either side of the incision, and a curved needle and silk thread is passed through its edge, and through the tissues and skin at the apex of the reopened wound. This suture is tied, bringing the gut well up to the angle. A couple of additional sutures may be necessary at the sides."

Colostomy Appliances. Until the patient has gained some control over the artificial anus or has learnt how to manage it, a dressing of lint smeared with some simple ointment and changed as often as may be necessary is the best for the patient. Later some form of belt may be fitted; this gives more general support and keeps in position better than a spring truss. Rubber belts sag and rarely fit. Lockhart Mummery⁵ advises "a belt round the lower part of the abdomen, that part of the belt which comes over the opening being made of pure smooth rubber or covered with a thin layer of mackintosh sheeting"; a small pad of wool may be worn under this. Plugs if hollow collapse and turn sideways; if made of rubber they soon perish. Mr. Paul recommended "a simple mushroom-shaped aluminium plug, retained in position by a pad of wool and a detached belt." Cups and bags tend to cause suction and prolapse.

¹ *Ann. of Surg.*, 1911, liii, 252.

² *Abdominal Operations*, 1926, i, 508.

³ *Ann. of Surg.*, 1910, lii, 384.

⁴ *Brit. Med. Journ.*, 1895, ii, 966.

⁵ *Diseases of the Rectum and Colon*, 1923, p. 825.

Complications and Difficulties in Inguinal Colostomy (1) Difficulty in finding the bowel This has been fully entered into at p 274 (2) Absence or shortness of mesentery I will here quote Mr Cripps ¹ This is perhaps the most unfortunate and dangerous complication that can be met with and to this cause with one exception I owe all my fatal cases In the great majority of cases the mesentery of the sigmoid flexure is amply sufficient to allow of the bowel being well drawn up in the wound and safely fixed without tension but in 3 or 4 per cent this is not so, for there is absolutely no mesentery the bowel being bound firmly back against the posterior parietes This is either due to congenital deficiency or to malignant disease behind the colon fixing it firmly The question to be considered is as to what should be done after the surgeon has opened the abdomen and met with one of these cases I am confident from my unfortunate experience that any endeavour to invert the skin and forcibly drag it down to the bowel by the sutures is a fatal mistake The sutures will certainly cut through leaving an open peritoneal cavity The surgeon should avoid mistaking the fixed descending colon for the sigmoid by tracing the bowel down into the pelvis where he may discover a pendulous and mobile loop of sigmoid which should be brought into the wound and opened if the obstruction be below it If the mesentery is really too short the difficulty can be overcome by incising the parietal peritoneum parallel to and an inch external to the colon and then mobilising the colon to the necessary extent by gauze dissection All the vessels of the colon reach it at its mesial border They are always long enough to allow the mobilised colon to be brought out of the wound without tension (3) Prolapsus The frequency of this after the operation has been explained at p 273 It may be met (a) by making the wound as high up as possible (p 273) (b) drawing down the intestine till the upper end is tight (Cripps) and then bringing it out through as small and valvular an opening as possible (c) closing this opening round the bowel as securely as possible whether a rod (p 275) has been used or no (d) keeping the patient at rest until the parts have had full time to consolidate (e) treating assiduously any such causes as constipation, coughing straining in micturition &c (f) trying the effect as early as may be of a light spring truss and pad The two following complications may occur during vomiting or coughing (1) Small intestine or omentum may escape between the piece of sigmoid which has been drawn out and the edges of the wound This accident may be known by the urgent vomiting, pain collapse and soaking of serum into the dressings which should, of course be removed at once the small intestine cleansed and returned, and the wound made safe by additional sutures This accident is most likely to occur when a large wound has been made an insufficient number of sutures used or sufficient support has not been provided by means of a belt of strapping (p 276) Where omentum protrudes—a much rarer complication—it may be left as it will all shrivel away gradually, but additional sutures should be inserted at once (5) A rarer accident, of which Mr Cripps has published an instance,² is where the bowel tears away from its attachments and falls back into the peritoneal cavity This happened on the seventh day during a violent fit of coughing

¹ *Brit Med Journ.* 1895 ii 966

² *Ibid* 1893 ii, 967

"The released bowel discharged a considerable motion into the peritoneal cavity. Fortunately, I saw the case about an hour after the accident. The faecal matter was thoroughly washed out from the abdomen, and the detached bowel restitched. The patient recovered."¹

This accident is not likely to happen when the abdominal wound is valvular, and a loop of bowel is brought out of the wound and held in position by a rod or suture passed through the mesocolon. It has occurred when the bowel has only been held up to parietal peritoneum by sutures, which are apt to tear out of the friable intestinal wall.

(6) Strangulation of small intestine between the attached sigmoid and the parietes. An instance of this very rare accident will be found recorded by Mr. Cripps.²

A patient on whom inguinal colostomy had been performed was about to leave the hospital when he was seized with symptoms of acute obstruction, the pain being referred to the colostomy opening. After vomiting three or four times the patient said he felt something slip in his inside; the vomiting ceased, and the pain suddenly left him. A few days after, feeling quite well, he was discharged from the hospital, and was readmitted ten days afterwards in a dying condition. The necropsy showed that a loop of small intestine had slipped down into a canal, about an inch long, between the attached portion of the colon and the reflexion of the parietal peritoneum, near the anterior superior spine. From this canal the intestine must have released itself at the first attack. Mr. Cripps adds that prompt abdominal section would have saved the patient.

RIGHT ILIAC COLOSTOMY

Indications. (1) Severe Degrees of Ulcerative, Dysenteric or Membranous Colitis. When these conditions are severe it is necessary to give the colon entire rest by draining all the faeces away through an artificial anus in the ascending colon. It is not possible to do this with a cæcostomy. (2) Occasionally for intestinal obstruction about the hepatic flexure, but as a rule it is better to perform either cæcostomy or short circuit between ileum and colon. In suitable cases the growth can be removed later.

Operation. The steps of the operation are very much the same as those already described under left iliac colostomy (p. 273), but, owing to the usual absence of a right mesocolon, the bowel cannot be brought out of the wound for the formation of an efficient spur without first mobilising the colon. This is easily done after incising the parietal peritoneum parallel to and about an inch external to the ascending colon. A little gauze dissection then allows the colon to swing forwards and inwards upon the vessels which enter it at its mesial border. When the colon is mobilised in this way this operation is very much easier and more satisfactory than a right lumbar colostomy which does not allow the formation of a proper spur to prevent faeces reaching the transverse colon.

TRANSVERSE COLOSTOMY

This may be performed as a temporary measure when a removable growth of the splenic flexure or descending colon is discovered during an exploratory laparotomy for acute following upon chronic intestinal

¹ Mr. C. Heath's remarks on this or a similar case (*Brit. Med. Journ.*, 1892, i, 1243) are worth the attention of any one inclined to think lightly of such an accident because the patient recovered. "Of course we hear of one case that did recover, but we do not hear of the ninety-and-nine cases which did not." The writer remembers a similar case which terminated fatally although the peritoneum was cleansed within a couple of hours.

² *Loc. supra cit.*, p. 967.

obstruction Under these circumstances it is far safer to perform a temporary colo tomy than to be too ambitious and to attempt a primary resection When the intestines have been emptied of their virulent contents and the patient has recovered from his immediate danger of death the growth may be resected and the colostomy closed or allowed to close later a short circuit is better for irremovable growth above the middle of the pelvic colon and a left iliac colostomy is better for irremovable growths of the rectum

Operation A vertical incision two inches long is made over the middle of the left rectus at the level of the navel and a loop of transverse colon is brought forwards through an opening made in a bloodless area of the great omentum and held outside the wound by a glass rod The operation is then completed as already described for iliac colostomy When the transverse mesocolon is short the operation may be very difficult or even impossible

When the cause of the obstruction is found to be a removable growth of the transverse colon it may be possible to bring the loop of bowel containing the growth outside the abdomen and to fix it there by means of a glass rod through the mesocolon or by sutures The surgeon having protected the abdominal cavity by careful gauze packing may then be content merely to relieve the obstruction by tying an enterostomy tube in the proximal limb of the loop Later he can resect the growth and close the artificial anus or the growth may be immediately removed and Pauls tubes tied in the two limbs of the loop the contiguous sides being sutured together to pave the way for the subsequent closure of the artificial anus¹

An artificial anus in the transverse colon is from its high position more manageable than a low sigmoid colostomy and from the more solid character of the faeces it is better than a right iliac or caecal fistula

Mr Bidwell² in an able article maintained that colostomy should never be performed for any growth that is situated above the middle of the sigmoid flexure and that an artificial anus made in such a case should be only a temporary one left after the removal of the growth In such cases ileo-sigmoidostomy or some other suitable form of ileo colostomy is far preferable for a surgeon skilled in abdominal surgery In skilled hands this operation is only a little more dangerous than colostomy, but for those less experienced and without the advantages of skilled assistance colostomy or cæcostomy remains the safest treatment

Mortality and Causes of Death after Colostomy The mortality of colostomy, which should be under 2 per cent has been greatly diminished by improvements in and especially by simplification of technic the mortality is now almost entirely due to delay and the causes of death are exhaustion intestinal toxæmia paralytic distension peritonitis (chiefly from ulceration and rupture of the distended bowel above the obstruction) and pulmonary complications

CÆCOSTOMY

Indications Cæcostomy is indicated as a temporary measure in certain cases of (1) obstruction (2) inflammation of the colon or (3) volvulus of the cæcum

¹ Bidwell *Brit Med Journ* 1902 : 377

² *Loc supra cit*

(1) In cases of acute following upon chronic obstruction of the colon this operation is very valuable as a temporary measure to save the patient from his urgent danger. Later the cause of the obstruction can be removed with comparative safety,¹ the cæcostomy acting as a safety valve as long as it may be required, after which time it may be allowed to close spontaneously. It very rarely needs to be closed by operation. There is no doubt that cæcostomy provides the quickest, safest and most thorough drainage of the distended cæcum. It drains the bowel low down and at the point of meeting of two currents—the one from the small intestine through the ileo-cæcal valve, which is still effective, and the other from the whole length of the colon backwards, by reverse peristalsis. The result of the meeting of these two currents in the cæcum is that this part of the bowel often becomes greatly distended and even paralysed, with secondary kinking at the hepatic flexure and with greater risk of rupture in this than in any other part. Drainage at the lowest point of this retort-like paralysed sac affords very prompt and adequate relief; but colostomy nearer the obstruction is more effective when the lower part of the colon is distended and more or less paralysed.

(2) As a temporary measure a valvular cæcostomy may be made for irrigation of the large intestine, in some cases of ulcerative colitis or dysentery. Mr. Z. Cope,² in his Hunterian Lecture, advocated this operation in preference to appendicostomy for irrigation purposes, but he advises complete ileostomy in bad cases of dysentery.

(3) In certain cases of volvulus of the cæcum, in which the bowel is replaced yet greatly distended and damaged, a temporary cæcostomy may be wisely done, and this may serve to fix the viscus and thus prevent recurrence.

A *permanent* cæcostomy is objectionable on account of the frequent and irritating discharges, which often induce troublesome inflammation and even ulceration of the skin of the abdomen.

In some of the above instances the primary incision will be over the cæcum, but when the surgeon has been exploring the site of an obstruction through an incision near the middle line and determines to open the cæcum, it is safer to do this through a second incision in the right iliac region.

Operation. This can be performed either under general or under regional or local novocaine anæsthesia. A small grid incision is made over the cæcum and its lower and external pouch is gently withdrawn,³ emptied back and clamped with a soft intestinal clamp. If the whole cæcum is delivered it may rupture. It is then packed off and incised, and a soft rubber tube (having an internal diameter of one quarter of an inch and two side holes close to the end) is inserted and fixed in with a single catgut suture piercing the edges of the small cæcal incision. The tube and incision are then invaginated with three purse-string sero-muscular sutures of catgut, thus making an "ink-bottle" cæcostomy.⁴ The

¹ T. Carwardine, *Practitioner*, 1905, lxxiv, 179, and Sir Harold Stiles, *Brit. Journ. Surg.*, 1922, lx, 1.

² *Lancet*, 1920, i, 579.

³ In some cases the cæcum may be so adherent that it cannot be brought out, in others it may be out of place. In one case I found it in the left hypochondrium; fortunately a peræmedian wound had been made to explore.

⁴ Gibson recommended a valvular cæcostomy after Kader's method of gastrostomy for the treatment of chronic colitis by irrigation (*Boston Med. and Surg. Journ.*, 1902, cxlvii, 341).

cæcum is replaced in the abdomen sewn to the peritoneum and muscle, and the parietal wound is closed round the tube. This method is far better than a simple incision into the cæcum and tying in a Paul's tube, which generally leads to sloughing and leakage within three or four days. The rubber tube drains comfortably for two or three weeks or more, without leakage or infection of the parietes and when it is left out the valve is generally so efficient that no leakage occurs on to the skin, in fact the tube has to be quickly replaced to prevent the cæcostomy healing. The cæcal contents, being liquid and gaseous drain easily through the rubber tube, through which the bowel can also be washed out and normal saline and glucose administered if necessary. For ulcerative colitis Lockhart Mummery advises irrigation with hypertonic solutions such as sea salt, 3u to one pint.

APPENDICOSTOMY

This operation was first described and practised by Dr Weir of New York¹. He was performing a cæcostomy for chronic colitis when the appendix presented itself just at the right moment and Dr Weir saw and took immediate advantage of his opportunity. Later the important contributions of Mr Keetley² and Sir W. H. Bennett³ brought the operation into more general notice and many surgeons have given it a trial.

Indications (1) For the introduction of irrigating or medicating fluids into the cæcum and colon in certain cases of chronic colitis and amœbic dysentery.

(2) For the introduction of fluids into the cæcum in a few cases of obstinate chronic constipation.

(3) For the administration of foods and fluids in a few cases of cachexia, noma of the stomach &c.

(4) For temporary drainage and fixation in some cases of ileo cæcal intussusception and volvulus of the cæcum.

(5) For the relief of intestinal distension in cases of peritonitis, &c.

These indications will be considered more fully after the description of the operation.

Operation (a) Under general local or regional anaesthesia, according to the state of the patient the appendix is sought through the usual but much shorter, valvular incision employed for its removal the aponeurotic and muscular fibres of the abdominal wall being separated and the peritoneum divided sufficiently to admit two fingers.

The appendix is drawn out through the wound so that the cæcum is brought into contact with the abdominal wall and two fine catgut sutures are passed through the sero muscular coats of the cæcum and the parietal peritoneum and tied so as to fix the cæcum and close the peritoneal wound without compressing the vessels of the meso appendix. Two catgut sutures are used to fix the appendix to the aponeurosis, as there is no Fig 173. If it is not certain that the appendix is patent it is so weak that it at once and try to pass a catheter. If this attempt fails, leath occurs, cæcostomy is performed.

¹ New York Med Record August 9 1903

² Brit Med Journ, 1900, ii 863

³ Lancet 1906 i 419

Care must be taken not to damage the vessels or subject them to much tension. Curl¹ mentions three cases in which the appendix sloughed even after careful handling. The dressings are carefully applied so that they do not interfere with the circulation of the appendix. After three or four days, when firm adhesions have formed, the appendix may be cut across a quarter of an inch from the level of the skin, and a conical silk catheter of suitable size is introduced for irrigation, and left out in the intervals so that it may not cause inflammation or even sloughing of the appendix. For the irrigation a Higginson's syringe is attached to the

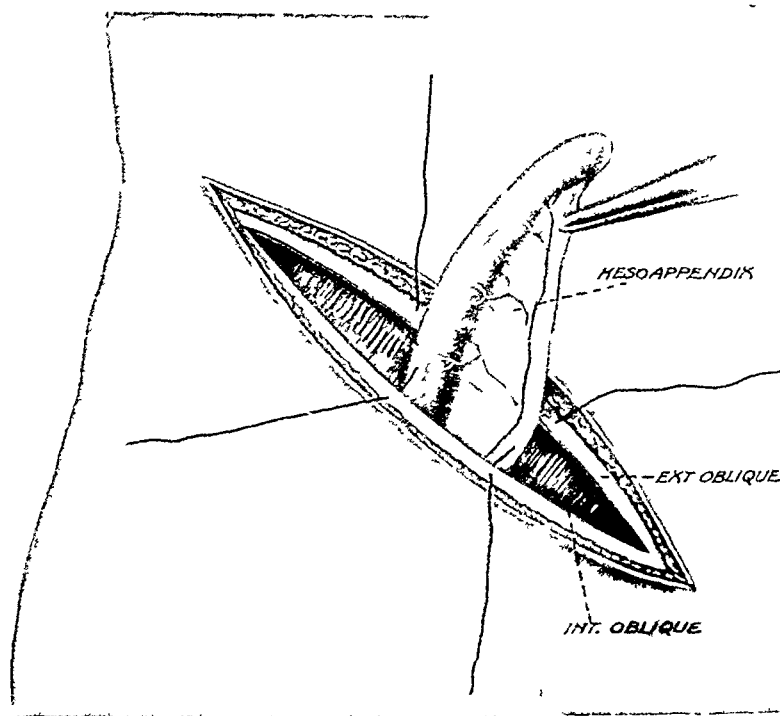


FIG 173 Appendicostomy.

outer end of the catheter, and the liquid is pumped gently into the cæcum and allowed to run out at the anus.

(b) During an exploratory laparotomy, the surgeon may decide to use the appendix as a temporary spout for the escape of fæces or gas, as recommended by Mr. Keetley.² A stab wound can then be carefully made in the abdominal wall over the appendix, which can be drawn out and fixed in the manner described above. If necessary the lumen can be stretched by means of fine-bladed forceps or by bougies. When the fistula has served its purpose it may be closed most easily by the cautery or a little nitric acid to the mucous lining, as recommended by Lockhart-Mummery,³ when the wound heals in a few days. out, in others fortunately a

¹ *Ann. of Surg.*, 1906, xliii, 545.

² *Loc. supra cit.*

³ *Diseases of the Rectum and Colon*, 1923, p. 440.

astrostomy
n, 1906

Appendicostomy is usually a very simple operation but occasionally it cannot be performed for the appendix may have been already removed or be so tied down with adhesions or so diseased and contracted at its base that it cannot be safely used Mr Spencer¹ found the appendix so adherent that he had to perform cæcostomy in one case In one hundred autopsies at St George's Hospital the appendix was a fibrous cord in two bodies and in two others the lumen near the base would only admit a small bristle but an appendicostomy could probably have been performed in the remaining ninety six

(1) **Colitis and Dysentery** As an alternative for open cæcostomy and right lumbar colostomy in the treatment of cases of colitis suitable for surgical treatment appendicostomy has the following important advantages (i) The fistula does not allow any leakage of feces because it is controlled by a sphincter at its base and is more or less protected by a valve of mucous membrane on its cæcal aspect thus the very troublesome irritation of the skin which is often associated with the older operation is entirely prevented (ii) The saving of the fluid contents of the cæcum for more complete absorption in the large intestine may be a gain especially in very feeble subjects thus Goddard maintains that about 10 per cent of the fat for instance is absorbed in the large intestine (iii) The appendicular fistula is very easily closed whereas the difficulties of closing an opening in the cæcum are well known

Valvular cæcostomy also generally guards against leakage and it often closes easily on removing the tube it is the best procedure to adopt when appendicostomy is impossible

The place of appendicostomy and irrigation in the treatment of ulcerative colitis is now well established the operation should be performed without delay when medical treatment has failed

Curl concludes from observation of eleven cases of dysentery that in intermediate cases in which there is still a reasonable amount of strength but where treatment is not controlling the dysentery the operation of cæcostomy with irrigation of the colon with quinine solution is indicated Cæcostomy is preferred to appendicostomy because of less sloughing and an earlier closing of the fistula A rapid improvement usually follows the beginning of the irrigation but convalescence is slow and at times difficulty is experienced in closing the fistula The after treatment—irrigation &c—is tedious and the patients are offensive cases to have in a ward All in all it is the lesser of two evils but in my opinion it saves lives in selected cases²

Curl does not state in how many of these cases he performed appendicostomy—presumably a minority only it is surprising to read that the fistula closed more rapidly in the cæcostomy cases Quinine solution was the irrigating fluid used in eight out of eleven cases partial or complete recovery occurred in two as demonstrated by autopsy there was extensive and deep ulceration and also nephritis One was so weak that cæcostomy was performed under cocaine anaesthesia and death occurred the following day

¹ *Lancet* March 12 1904

² *Ibid* March 25 1905 p 795

³ *Ann of Surg* 1906 xli 543

Many kinds of irrigating fluids have been recommended, such as normal saline solution, starch, infusion of marshmallow, oil, lime water: various astringents, such as nitrate of silver solution, ipecacuanha in suspension, glyco-thymolin, argyrol, liquid paraffin, two ounces daily (Ewart); quinine solution for dysenteric cases (Curl).

Lockhart-Mummery¹ believes that a hypertonic solution of sea salt, 5ii to one pint, is as good as any and draws attention to the danger of using toxic solutions which are easily absorbed in the cæcum.

It is certain that the hopeful results obtained depend more upon the careful lavage than upon any particular kind of chemical solution used. The patient should not complain of pain during the irrigation unless the outflow be obstructed or too much pressure employed. The patient should be kept supine unless the fluid does not run well, when he may be turned on his left side to overcome any possible obstruction at the hepatic flexure of the colon.

(2) **Chronic Constipation.** Murray² first suggested appendicostomy as a treatment of intractable cases of chronic constipation. Since then Keetley³ and others have tried the operation. As a rule it only alleviates the symptoms, but Mummery⁴ records cure in one bad case.

(3) **Ileo-Cæcal Intussusception.** Keetley⁵ performed appendicostomy, after reducing an intussusception of the lower end of the ileum, cæcum and appendix in an infant aged one year and ten months. The reduction was performed through an incision in the right rectus, and then the appendix, six and a half inches long, was pulled out through a button-hole incision made over it, and the end was cut off and the stump fixed. ʒviij of normal saline were injected at 6 P.M., and the bowels were moved at 7 P.M. and 9.45 P.M. The stump of the appendix was removed fifteen days later, but its site was fixed to the wound.

The operation was performed for several reasons: for the relief of gaseous distension, the administration of fluids which acted partly as aperients, and fixation of the bowel with a view of preventing recurrence.

The appendix would probably be of even more service in cases of primary cæcal intussusception.

(4) **Volvulus of the Cæcum.** The following interesting case recorded by Maunsell is probably the first in which appendicostomy has been tried for volvulus, and it is certainly encouraging.

Female, æt. 77, subject to chronic constipation. Volvulus of the cæcum was discovered in the pelvis on exploration; the greatly distended cæcum was deflated and then withdrawn and uncoiled and the puncture closed. The appendix was brought out through a stab wound at the outer border of the right rectus. Some vessels of the meso-appendix had to be tied; the appendix was fixed by two sutures and its distal end amputated. The fistula was dilated with sinus forceps and a gum-elastic catheter tied and left in for four days. From the first gas and some fluid faeces escaped from the opening and the abdomen kept flat. Later the mucous membrane lining of the stump was excised and the fistula closed in a few days. The patient did very well although some suppuration occurred in the exploratory wound, probably due to soiling during deflation.

(5) **Intestinal Obstruction.** In 1894, Keetley⁶ first suggested the use of the appendix as a spout for the relief of intestinal obstruction, instead

¹ *Ann. of Surg.*, 1906, xliii, p. 437.

² *Brit. Med. Journ.*, 1905, i, 1299.

³ *Ibid.*, 1905, ii, 863.

⁴ *Diseases of the Rectum and Colon*, 1923, p. 345.

⁵ *Loc. supra cit.*

⁶ *Brit. Med. Journ.*, November 17, 1894, p. 1155.

of caecal colostomy. He was able to put it to a successful test in 1905.¹ The operation has a very limited application for the drainage it provides is not sufficient in cases of complete intestinal obstruction, and ulceration may develop in the ileum and lead to perforative peritonitis. Valvular caecostomy is much better.

In cases of severe intestinal distension embarrassing the breathing and leading to paralytic distension of the intestine if unrelieved appendicostomy may prove to be a simple way of giving great relief especially is this likely to be so in some cases of general suppurative peritonitis and some cases of intestinal obstruction after removal of the cause.

¹ *Lancet* 1906 i 1023

CHAPTER XV

ENTERECTOMY AND COLECTOMY CARCINOMA OF THE COLON

THE term enterectomy is generally limited to resection of a part of the small intestine, and colectomy to resection of a part or the whole of the colon, but the operations merge into each other and are best described together.

Indications. Resection is usually a severe and sometimes a grave operation, which should not be undertaken when a simpler and safer method is sufficient, *e.g.*, the simple suture and inversion of a perforation or wound of the intestine. Lateral anastomosis for innocent stricture is often as efficient and far safer than resection although it is not so spectacular. The most common indications for enterectomy are injuries and gangrene of the bowel. The most common indication for colectomy is malignant disease of the colon.

(i) **Severe injuries of the bowel or mesentery** (*see* Chapter XIII.).

(ii) **Gangrene of the bowel in a strangulated hernia or due to intestinal obstruction, intussusception, volvulus, embolism or thrombosis of the mesenteric vessels**, but resection is not always the best treatment. **The treatment of gangrenous strangulated hernia** may be taken as an example.

Relief of a strangulated hernia is one of those operations of emergency, sometimes admitting of no delay, which a general practitioner must undertake, often under very unfavourable circumstances. It would be most unfair to expect that such a man, when face to face with a gangrenous hernia, should meet it in the same way as a hospital surgeon, able to command the very best surroundings, abundant help, and himself experienced in intestinal surgery. As I have said in Chapter II, when the condition of the patient, the experience of the operator and his surroundings admit of his taking this step, resection of the gangrenous intestine should always be performed. Where the above conditions are absent, the operator must rest content with division of the constriction at the neck of the sac, incision and free drainage of the bowel, a rubber tube being passed up into the distended bowel above the neck of the sac.¹ This will avoid the terrible risks of paralysis of the bowel, ster-coraceous vomiting, exhaustion, and toxæmia. Any gangrenous omentum must be removed, and the sac cleansed as far as possible.

Sometimes the gangrene is so limited that resection is not the safest treatment. Five cases of partial gangrene of the intestine treated by inversion of the gangrenous or ruptured portion are very briefly given in an instructive but very short paper by the late Mr. Caird:²

All five were cases of hernia. There was a "perforation" of the intestine in one, and a "rupture" in two. Of the five cases three recovered. Of the two which died, one was an infant aged 18 months. The necropsy showed firm union of the intestine without peritonitis. "The intestine was beset with typhoid ulcers of ten or fourteen days' duration."

¹ In a very few cases, where the surroundings are even more unfavourable, the operator may have to be content with simply opening the bowel and doing no more.

² *Edin. Med. Journ.*, 1895, p. 312.

The following is Mr Caird's advice as to the treatment of gangrenous intestine by inversion and the cases suitable to this method. If we meet with the typical elliptical necrosis of the bowel which runs longitudinally opposite the mesenteric attachment we may with Lembert's sutures stitch the sound tissues over the unhealthy thus inverting the gangrenous area into the lumen. This practice which obviates the necessity of cutting any part of the bowel away and requires no special dexterity is in all probability not applicable with safety where more than one third of the circumference is destroyed. The fear of stricture ensuing rather determines us to resect in such cases. The method of inversion although easy cannot be modified to meet the exigencies of every case. It does not lend itself to those instances in which the gut is almost completely divided by the tight grasp of a narrow femoral ring. The vitality of the proximal end has then been too severely tried to admit of such an experiment. We should require to invaginate a few inches of the damaged gut before we came upon healthy tissue to suture and since it is impracticable to reproduce the successful natural cure occasionally seen in cases of intussusception we are driven to resect. If inversion be made use of the greatest care must be taken as in partial or complete resection to ensure that the sutures lie in healthy tissues.

Sir George Makins¹ also draws attention to the value of inversion in some cases. He records two successful operations in one of which an area three quarters of an inch in diameter was inverted.

(iii) **Malignant disease, usually carcinoma, of the bowel or invading it.** This is common only in the colon but it may occur in any part of the small intestine. Tatlow* has recorded three interesting cases under the care of Sir Berkeley Moynihan. In one of these the growth was at the duodeno jejunal flexure. In two cases the growth was successfully resected. The third was too late for radical treatment and was treated by lateral anastomosis.

(iv) **Tuberculous disease of the small or large intestine, causing one or more strictures usually in the ileum or tumour like masses from infiltration of the walls of the bowel.** This occurs in the cecum and has been mistaken for malignant disease. Usually the mesenteric glands are also affected. In many cases lateral anastomosis or ileo colostomy with exclusion is the only justifiable operation and it is generally satisfactory in relieving the chronic obstruction and in causing resolution or fibrosis.

(v) **Chronic inflammatory affections such as colitis with pericolitis and chronic obstruction commonly but not always due to inflammation spreading from diverticula of the colon² (see p. 419).**

(vi) **Fæcal fistulae, which cannot be closed satisfactorily in any other way.**

ENTERECTOMY

The technic of the operation naturally varies with the nature and extent of the disease. Thus the mesentery containing infected lymphatic glands must be freely excised in the rare cases of malignant

¹ *Clin. Soc. Trans.* 1903 xxxv: 183

² *Lancet* 1912: 991

³ W. H. M. Telling *Lancet* 1908 pp. 843 and 98. R. P. Rowlands *Lancet* 1910: 1104 and (with A. F. Hurst) *Guj. Hosp. Reps.* 1925 lxxv: 46.

disease of the small intestine, whereas only a little of it needs removal with gangrenous bowel.

There are several methods of joining the bowel after the diseased part has been removed :

- (i) *End-to-end union.*
- (ii) *End-to-side union after closing the lower end.*
- (iii) *Side-to-side union after closing both ends.*

(i) **Enterectomy with End-to-End Union.** (a) As a typical example the *resection of gangrenous small intestine found in a strangulated hernia* will be described in detail. Usually a considerable length of bowel has to be removed.

The first question that arises when resection is determined upon is whether we should carry it out through the original wound enlarged or through a second in the abdominal wall. In umbilical or inguinal hernia, it will be sufficient to enlarge the wound if necessary either to allow an extensive resection to be carried out, or to facilitate the reduction of the sutured intestine and the bulky mesentery.

In femoral hernia it is wise to make a fresh incision through the lower part of the corresponding rectus sheath, unless the amount of bowel to be removed is very small. This is better than to have to divide Poupart's ligament, in order to get a proper view of the damaged bowel above the obstruction. This ligament will have to be divided if the resection is completed below the femoral canal, otherwise it will not be possible to reduce the sutured bowel and the mass of mesentery without exerting undue force. A. E. Barker¹ was compelled to sever Poupart's ligament on this account after the resection of eighteen inches of small intestine ; a large hernia developed at the site of the operation and had to be treated by another operation two and a half years later.²

A hernia is not likely to form at the abdominal wound which should be valvular and sutured with due care. The adoption of this second incision will, of course, involve a risk of carrying infection into the peritoneal sac and the abdominal wound, and every precaution must be taken to lessen this danger, which has been exaggerated. Any gangrenous or septic omentum having been tied off and removed, the sac and damaged intestine are carefully cleansed, any opening in the bowel being temporarily but firmly closed, and then drawn upwards and out through the abdominal wound.

The second question concerns the length of bowel to be resected. Care should be taken to remove too much rather than too little, for we find in many of the fatal cases reported that the cause of death was attributed to gangrene spreading upwards above the seat of suture ; on the other hand, we find that recovery has followed even when large portions of the intestine have been removed. A. E. Barker³ has successfully resected over six feet of small intestine for gangrene of a loop due to femoral hernia in a woman of sixty-three years. Peck⁴ removed eight and a half feet of gangrenous small intestine without any subsequent loss of nutrition during the succeeding two years ; at the end of this time an

¹ *Lancet*, 1903, i, 1579.

² *Clin. Soc. Trans.*, 1905, xxxviii, 136.

³ *Loc. supra cit.*

⁴ *Ann. of Surg.*, 1903, xxxviii, 451.

operation was performed for the relief of a ventral hernia, and the bowel was examined and found to be normal in appearance no sign of the line of union being seen Kocher quotes Monari to the effect that up to seven-eighths of the intestine of animals may be removed without harm and Roux has recorded the case of a patient who survived with only five feet of small intestine and half the length of his large intestine¹ Whitall² has successfully resected ten feet eight inches of the ileum and the patient, a woman recovered without any sign of malnutrition He draws attention to the fact that more of the lower part of the small intestine than of the jejunum can be removed without detriment

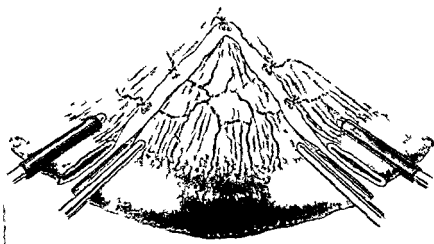


FIG. 174. Resection of gangrenous loop of intestine. The bowel is divided obliquely so as to ensure a good blood supply to the free border.

In any variety of strangulated hernia the intestine above the obstruction must be examined and the site for the upper line of section should be chosen with great care. The lower section may be made about two inches below the lower constriction.

No paralysed, congested or greatly distended bowel should be left behind, failure to remove enough may lead to death from toxæmia, paralytic distension, enteritis or peritonitis, the latter being due either to sloughing of the upper end at the line of suture or to infection of the peritoneum through the wall of the damaged intestine without any visible perforation. Mr Barker³ has strongly advocated more extensive resections in all cases which need resection at all. Sound tissues may thus be obtained for suture and paralysed intestine in a condition of infective cellulitis may be removed together with pints of poisonous contents which would otherwise become absorbed to some extent with lethal effects. Temporary valvular enterostomy, however, may be added to a less extensive resection, provided the sections are made through healthy vascular tissues, the retained products are thus removed.

¹ Kocher *Oper. Surg.* 260.

² *Ann. of Surg.*, 1911, 11: 559.

³ *Loc. supra cit.*

Clairemont and Ranzi¹ have shown how poisonous these retained products are, and others have proved how virulent the bacillus coli becomes in cases of intestinal obstruction.

It is important to examine the mesentery to find out the condition of its blood-vessels, the presence of pulsation and the absence of cedema or extravasation of blood being essential at the line of section.

Barker points out that an extensive resection takes very little more time than a small one, and that there is hardly any difference in the amount of shock induced.

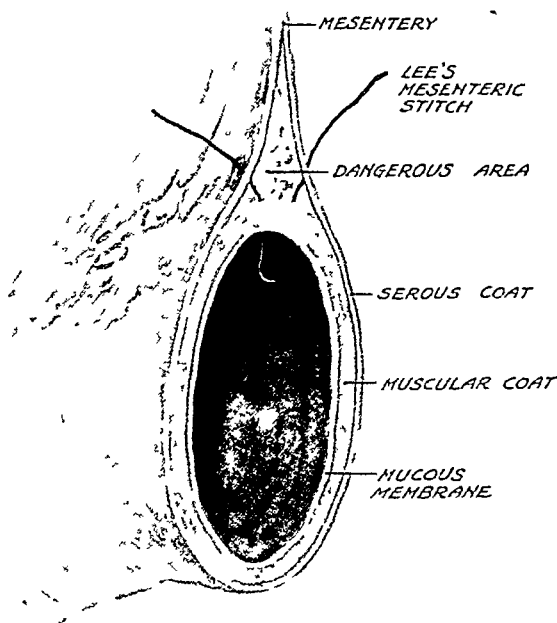


FIG 175 Section of small intestine and mesentery, showing the various layers and the mesenteric space or dangerous area.

Operation. The intestine to be removed is drawn well out of the wound, and its base surrounded with two layers of moist gauze packs to protect the wound and peritoneum. Two clamps are placed obliquely, half an inch apart, at each end of the loop and the mesentery is tied in sections and divided as shown in Fig. 174. The bowel is then divided with a sharp knife run along the two clamps used to close the gangrenous loop. Half an inch of intestine (which should be almost empty) now projects beyond each sheathed clamp, and these are cleansed with moist swabs without contaminating instruments or gloves.

End-to-End or Axial Union. In joining the ends together the mesenteric space must be obliterated in order to secure peritoneal apposition and prevent leakage at this dangerous point (see Figs. 175 to 177). The clamp forceps are held, locked or tied together. The first half of the sero-muscular suture having been inserted a mattress suture of fine linen thread

¹ *Ann. of Surg.*, 1903, xxxviii, 914.

is inserted at the mesenteric border (as shown in Fig 177), and tied within the bowel. This completely obliterates the mesenteric triangle and also inverts the edges of the bowel. To maintain inversion of the edges, keep them taut and raise them up, tissue forceps are applied at the free

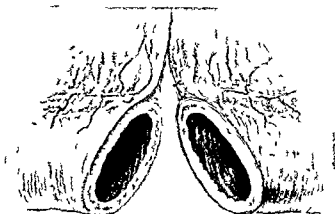


FIG 176 The sections run obliquely across the intestine to secure an adequate channel after suture and a reliable supply of blood to the free edge. Two sutures are shown obliterating the dangerous space on the right side. Clamps are always used.

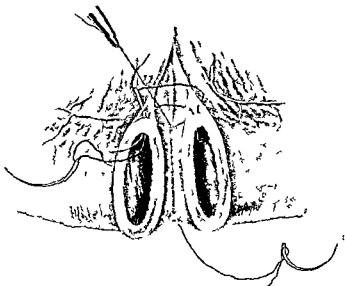


FIG 177 Lee's mesenteric stitch to obliterate the dangerous space. The first half of the serous suture is also shown. The clamps are not shown.

border (Fig 178). One end of the long suture is used as a continuous suture to unite the edges which lie in contact and are inverted. The thread secures a good, but not excessive, bite and pierces the bowel at intervals of one eighth of an inch. When the free border is passed the

other end of the suture is used to close the remainder of the wound. In this way the finishing-point is well away from the dangerous mesenteric border, and more easy to see and invert properly. Both ends of the suture terminate and are tied together on the mucous surface. This lessens the risk of leakage at the knot (see Fig. 179). The sero-muscular suture is now completed (Fig. 180).

The intestine and mesentery are cleansed with moist swabs and replaced within the abdomen after the packs have been removed. *Firm union is most likely to occur when the joined intestine is completely surrounded by peritoneal surfaces which soon adhere to and protect the line of*

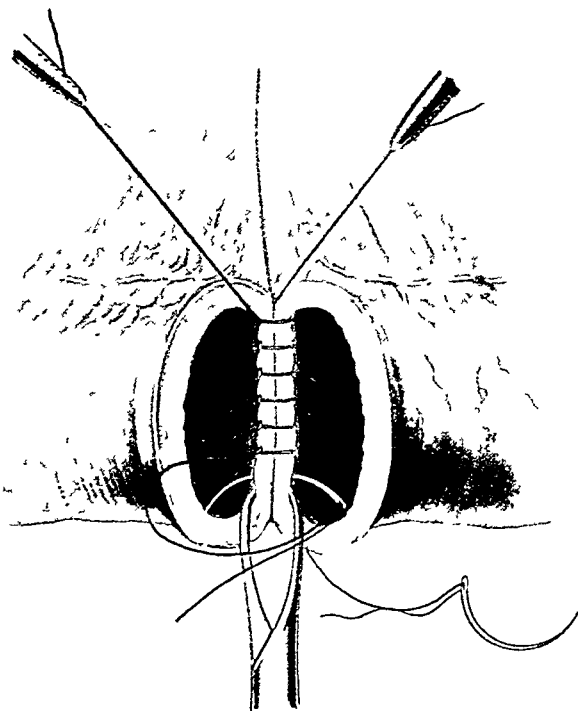


FIG. 178. The button-hole stitch : this does not run and narrow the channel

suture. When this desirable protection is not available failure of union and the formation of fistula are not uncommon. For this reason it is rarely wise either to leave sutured intestine exposed in the wound, or to insert a drain down to the suture line.

Advantages and disadvantages of Circular Enterorrhaphy.

Advantages. End-to-end union by simple suture seems to be ideal in its apparent simplicity, almost perfect restoration of the natural shape and condition of the bowel and the entire absence of any special or complicated apparatus which may not be always available. No troublesome foreign body is left behind which may give trouble before it comes away.

Disadvantages. It must be remembered, however, that although the channel may be completely restored the nerve supply may be interrupted, and that this may interfere with the natural wave of peristalsis and lead

to dilatation of the intestine above the anastomosis especially when there is any narrowing at the anastomosis as so often happens with end to end union. End to end union is unsuitable for joining intestines of unequal calibre

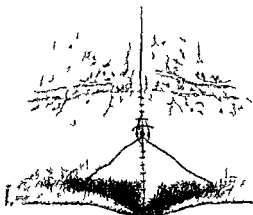


FIG 179 The deep suture nearly completed The knot is placed on the *mucosa*

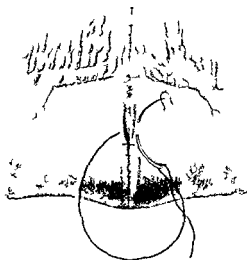


FIG 180 The serous suture after Cushing's method The mesenteric gap has been closed

Other Methods of End to End Union To avoid some of the dangers and difficulties of circular enterorrhaphy various modifications and mechanical aids have been introduced but few of these have stood the test of time and most of them have become obsolete as a result of improvements in the technique of the various methods of anastomosis by simple suture Maunsell's¹ method of suture is still occasionally used but

¹ *Amer Journ Med Sci* March 1892

it has been largely replaced by Connell's method, which is simpler and does not require an additional wound in the bowel (Figs. 181 and 182).

"Aseptic" Intestinal Anastomosis. Many attempts have been made to unite the bowel in a perfectly aseptic manner, *i.e.*, without the possi-

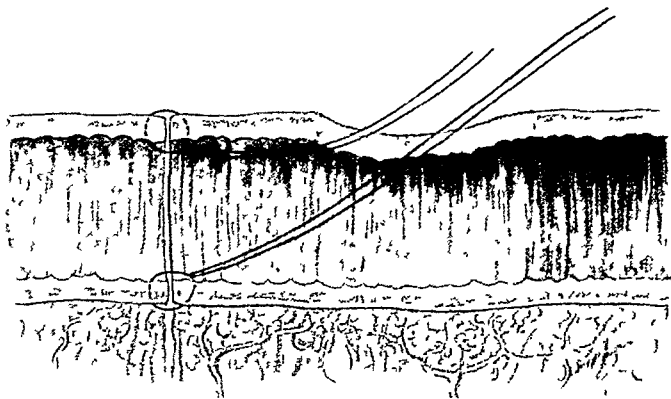


FIG. 181. Maunsell's method. The sutures D D serve to invaginate the ends and bring them out through a lateral incision for suture

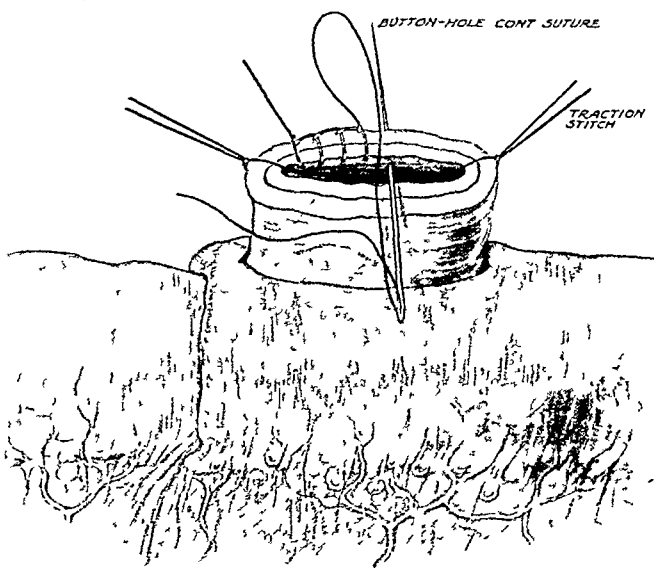


FIG. 182. Maunsell's method. The invaginated ends brought out through a side opening are sewn with a continuous button hole suture.

bility of contamination from the contents. The following is Schoemaker's description of his own method :¹ " Suppose that it is necessary for me to do a resection of the colon. The first great consideration is asepsis. We all know that the colon is full of germs and that it is impossible to make it quite empty. In addition, I wish if possible to do a simple operation : to remove the growth and suture the intestine end-to-end as is done

¹ *Surg., Gyn. and Obstet.*, 1921, XXXII, 592, and private letter to us in November 1926, modifying the method

in operating upon the small intestine. If no ileus is present I should like to do the operation in one stage and leave the intestine in as nearly normal position as possible and so that there will follow no adhesions to the abdominal wall.

The only way to operate aseptically is to suture the gut with the lumen closed. The clamps must remain in place until the suture is complete. But to suture the gut properly I must see the three layers of it for I want to sew them separately. The technique I use is as follows. After I free the tumour of its adhesions and ligate the mesocolon I make a circular incision in the intestine through the serosa and the muscular layer but not through the submucosa and mucosa. I push the serosa and muscular layer with the knife to either side thus making a

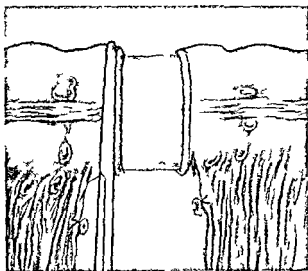


FIG. 183. Aseptic intestinal anastomosis (after Schöemaker). The clamps are in contact with each other, one on the mucosa and the others on the serosa of the part of the intestine that has to be taken away applied so that they are not likely to slip.

tube of mucosa about half an inch long. The clamps are placed close together and between the two the intestine is cut. The clamps I use are very small. They are about the size of a Kocher artery forceps. I have not been successful in using the Kocher forceps for they always slip off unless I leave a fold of mucosa outside the blades and this is just what I do not wish to do if I am to make an aseptic suture. Therefore I have modified the forceps by making a deep slit in the blades and in this slit the fold of mucosa is firmly held.

After the colon is cut at either side of the tumour the ends which are closed by the clamps are brought together to be sewed. I begin at the front side as shown in Fig. 185 and when the row of stitches at this side is finished I turn the colon round on its own axis bringing the handles of the clamp upwards. The posterior wall comes to the front and the sutures can be made as easily as at the real front side. Beginning at the front side makes the suture much easier than beginning at the posterior wall. The last stitch cannot be tied until the forceps are taken

off. The forceps are removed by an assistant, and just at the moment he releases them the knot is drawn tight by the operator. I suture the serosa with a continuous stitch, and the union of the intestine is complete.

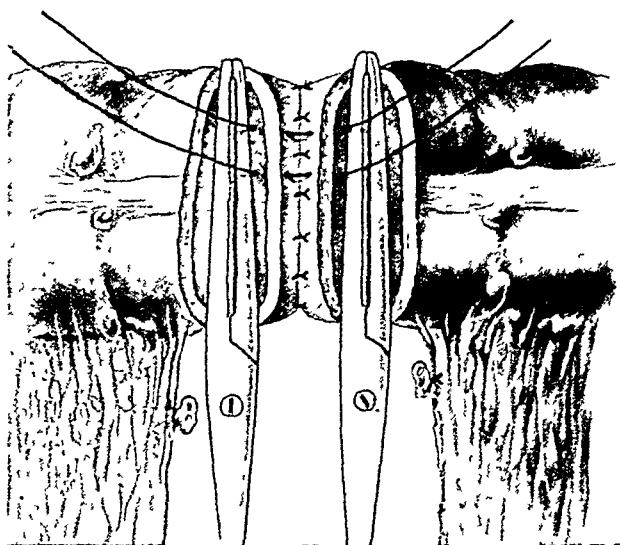


FIG. 184. "Aseptic" intestinal anastomosis (after Schoemaker). Clamps rotated to allow insertion of two layers of posterior sutures. Schoemaker now passes all the deep sutures as in Fig. 185, and uses a continuous serous suture.

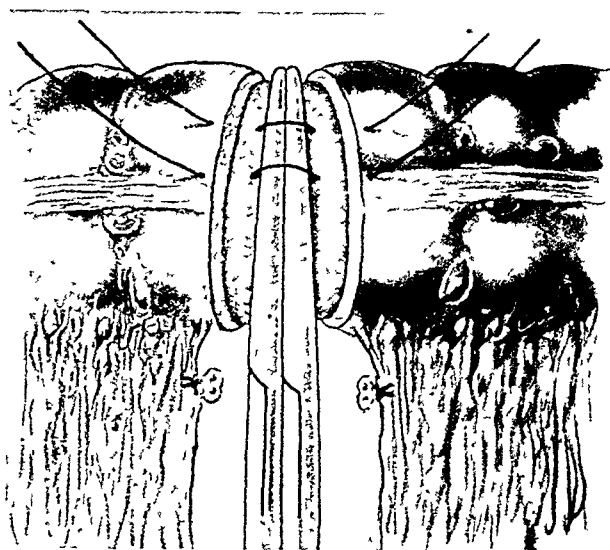


FIG. 185. "Aseptic" intestinal anastomosis (after Schoemaker). Insertion of deep layer of anterior sutures.

During the whole operation the lumen of the colon has not been opened and we have not seen or touched the inner side of the mucosa.

"I have performed this operation 40 times for cancer of the colon, with 3 deaths. It is remarkable that in these three cases the carcinoma

had already extended beyond the intestine and had grown into the surrounding tissue.

"I have used the clamps 179 times in removing the cæcum, the ascending colon, and a part of the transverse colon, in cases with pericolicitis associated with obstipation. In this series I have lost but two cases, one from pneumonia and one from embolus in an artery of the lung. In these cases I did not make a true colon suture, but anastomosed the colon with the ileum. However, this is done in exactly the same manner—I always use the end to end suture. This is easily possible with the clamps because I stretch the small intestine perpendicularly to its long axis before I put the forceps on, and at the same time I compress the colon a little so that the one fits the other."

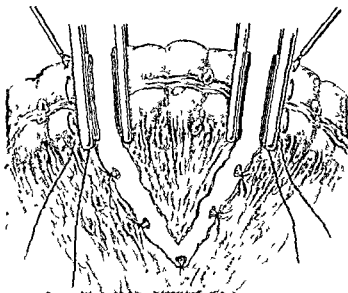


FIG 186 Colic resection after Fraser and Dott. The bowel has been divided between pressure and crushing clamps, purse string sutures have been inserted, and the guillotines used for dividing the purse strings are shown in place.

John Fraser and N. M. Dott, after successful experimental trials, have applied their hopeful methods to clinical cases of cancer of the colon. I venture to quote from their own account¹

"The only special instruments required are the two ligature guillotine tines (Fig 186), the usual crushing clamps² are employed, but controlling clamps are dispensed with.

"1. Resection (Fig 186).—The resection is carried out in the usual manner. The mesentery and lymphatic fields are mobilised as may be necessary, the segment of bowel to be removed is secured at each end by pressure forceps, the mesentery is perforated at these points, and it is secured and cut so that a wedge shaped portion is removed. Strong crushing clamps are applied to the gut close to the two pressure forceps, and the gut is divided between them at each end. The segment of bowel

¹ *Brit Journ Surg*, 1924, xi, 442

² Payr's model is very convenient for the purpose.

enclosed between the pressure forceps, with its attached mesentery and lymphatic field, is removed immediately *en bloc*. The division may be made either by the electric cautery or by the knife; in the latter case the section is carried flush with the clamp, and the cut edge touched with liquid carbolic acid. The vessels of the resected mesentery may now be tied off.

"2. Preparation of the 'Blind Ends' (Fig. 187).—The ends of the gut are now to be ligatured, and it is safer to employ a purse-string suture for the purpose in order to obviate the risk of its slipping. The ligature guillotine is threaded upon, and placed about the middle of a strand of

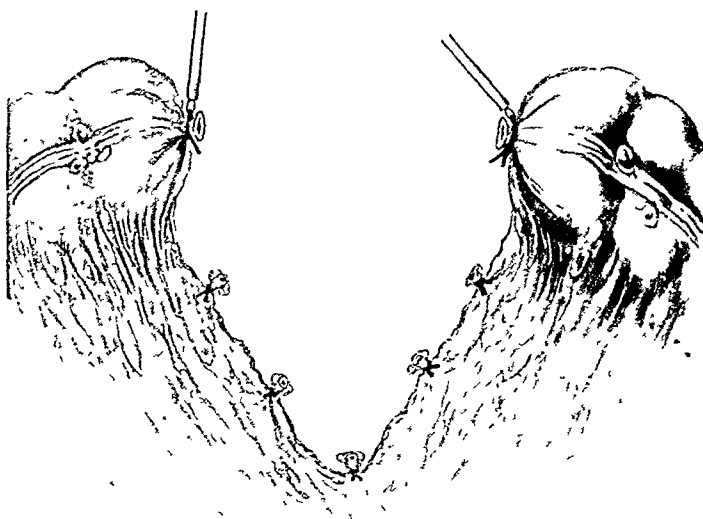


FIG. 187. Colic resection (after Fraser and Dott). The purse-string sutures have been tied.

strong catgut, and each end of the latter is armed with a needle. The suture is inserted close to the edge of the crushing clamp. Commencing with one needle at the antimesenteric border of the bowel, a few points of sero-muscular suture are taken up to terminate at the mesenteric attachment. With the other needle the procedure is repeated on the other half of the circumference. Thus, when the ligature is tightened, the guillotine remains attached to the antimesenteric border, while the knot is at the mesenteric attachment. As the clamp is released the ligature is drawn tight and tied as above. The end of the bowel is converted into a 'blind end,' with a minute stump of thoroughly crushed tissue projecting at its centre (Fig. 187). Although the crushed tissue contains no mucous membrane, we have taken the precaution of making a further application of the cautery or of liquid carbolic acid to it to ensure asepticity. The ease with which the stump can be invaginated into the end of the bowel should be tested, that there may be no tension on the anastomosing sutures. If necessary the mesentery should be further divided, to permit of easy inversion. It will be noted that the ends of the bowel have been prepared for anastomosis without at any time exposing the mucous

membrane They are aseptic and securely closed, so that they can be freely handled without apprehension of contamination

"3 Reconstruction of Continuity—It is convenient to close the gap in the mesentery in the first place and the guillotines attached to the ends of the bowel employed as tractors greatly facilitate this procedure The mesenteric borders of the ends of the bowel are approximated by a mattress suture and three or four interrupted stitches uniting the remainder of their circumferences form the first line of union (Figs 188, 189) The stitches of tanned catgut should penetrate to the submucous coat As they are tightened the stumps are allowed to invert slightly

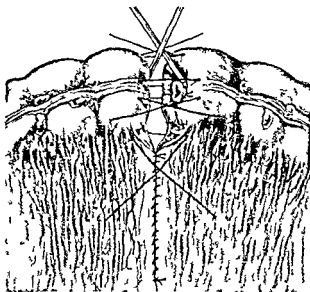


FIG 188 Colic anastomosis (after Fraser and Dott)
Mesenteric gap closed and mattress sutures are shown

into the ends of the bowel The ends form a double diaphragm across the lumen The thin guillotines are allowed to project together through the suture line at the antimesenteric border If the field of operation is difficult of access it is well to pay special attention to the area of mesenteric attachment, inserting two or more superimposed mattress stitches before the remainder of the circumference is united By this precaution easy access to the 'danger point' and its secure closure are ensured in the most difficult case A circular Lembert suture of fine tanned catgut is carried round the circumference of the anastomosis Commencing at one side of the guillotines on the antimesenteric border, it passes round to the mesenteric attachment the needle is passed through the mesentery eye first and the suture continued to reach the antimesenteric border again It is completed by taking a loose stitch over the guillotines (Fig 189) The original ligatures on the stumps are now cut by means of the guillotines, and the latter are withdrawn The loose stitch is tightened and tied off, so closing the point of exit of the instruments In this way the stumps are released and intestinal continuity is re established In this way the resection and anasto

mosis can be carried out rapidly and aseptically, and they can be performed in situations which would preclude the use of controlling clamps, and in which the ordinary methods of suture would be extremely difficult or impossible. Although their description is necessarily somewhat intricate,

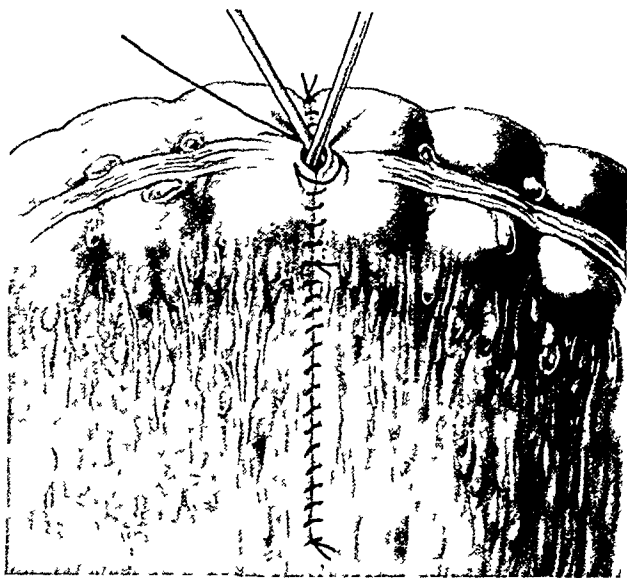


FIG. 189. Colic anastomosis (after Fraser and Dott).
Continuous circular serous suture nearly completed.

the resection and reconstruction can be completed easily within fifteen minutes in a straightforward case."

At the time of writing the above article Mr. Fraser and Mr. Dott had applied their method to two cases of carcinoma of the colon, with apparent

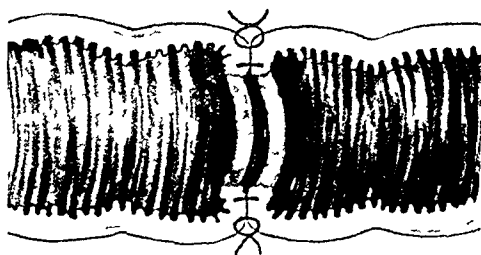


FIG. 190 Colic anastomosis (after Fraser and Dott) Sectional view of completed anastomosis
The inturned cuff is made smaller than in the original figure.

success, but in one case "seven months after the original operation a second operation was necessary to correct a diaphragmatic semi-obstruction. It is apparent, therefore, that there is a danger in excessive invagination of the bowel wall."

Mr. Seton Pringle tried to simplify this method by using a pair of forceps with very narrow blades to close the crushed ends of the bowel,

thus eliminating the need of a ligature and the special guillotines (see Figs 191 to 193)

These methods are worthy of careful consideration and improvement but they have not yet replaced the time honoured methods of intestinal

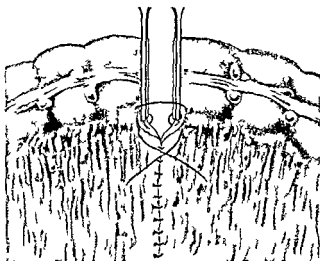


FIG 191 Intestinal anastomosis (after Seton Pringle)

anastomosis which with care can be used with but little risk of infection and without any danger of secondary obstruction taking place at the anastomosis

Enterectomy with End to Side Union This method is sometimes

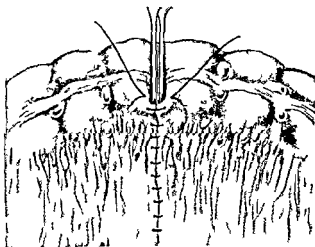


FIG 192 Intestinal anastomosis (after Seton Pringle)

very convenient especially when the parts to be joined are of unequal calibre e.g. when after excision of the cæcum the ileum has to be joined to the colon or when the small intestine dilated above an obstruction has to be united to the shrunken bowel below This method of anasto

mosis is also commonly used when performing ileo-colostomy for irremovable growth of the upper part of the colon.

It is better to implant the proximal in the terminal piece of intestine, for then peristalsis in the proximal intestine hurries the contents directly through the anastomosis instead of towards a blinded end, which is very likely to lengthen, distend and even to give way under pressure. On the other hand, when the open end of the terminal piece of intestine is closed, the peristalsis is always away from it so that no undue strain is put upon the inverted end.

It is fortunate that this method allows a dilated proximal bowel to be implanted into a smaller terminal, for there is no limit to the length of the longitudinal incision which can be made in the latter. The danger

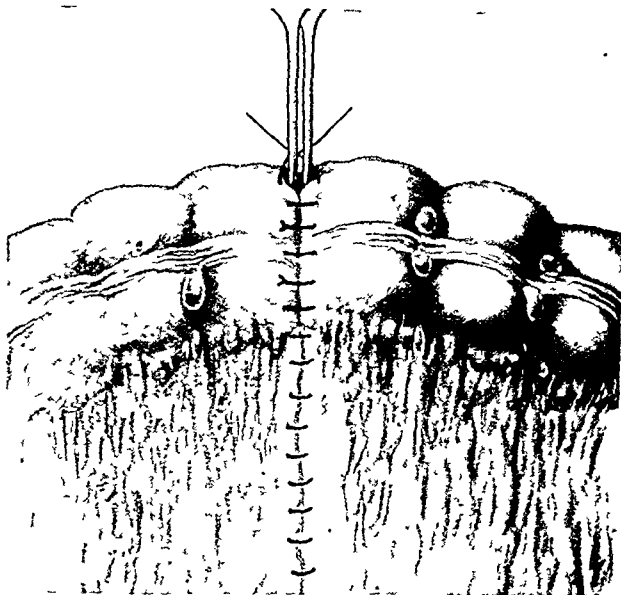


FIG. 193. Intestinal anastomosis (after Seton Pringle).

of the mesenteric space only concerns the implanted end and can be easily overcome. The union is not so neat as end-to-end union, but it is easier and, I think, safer, especially when dealing with bowels of unequal calibre.

Operation. A free incision through the inner and middle third of the right rectus is made. The edges are carefully enveloped with protecting pads, the diseased part of the intestine is identified and withdrawn, and two layers of packs are carefully placed around the bowel so that nothing can either leak over the wound or into the abdomen. The extent of the resection is decided and the mesentery of this part is tied in segments well beyond the disease. Sometimes a wedge-shaped piece including diseased lymphatic glands or thrombosed blood-vessels containing septic clots has to be removed. In any case fewer ligatures are required when they are placed well away from the bowel. Usually the ligatures extend along a semi-lunar or V-shaped line, the first and last ligature touching the bowel at the extremities of the loop to be resected. Two clamps are applied rather obliquely at the upper end

of the loop with their points holding the mesentery on either side of the row of ligatures already described. They are placed one inch apart, and before they are locked the bowel between is emptied. At the lower end of the loop only one clamp is applied and half an inch below it the

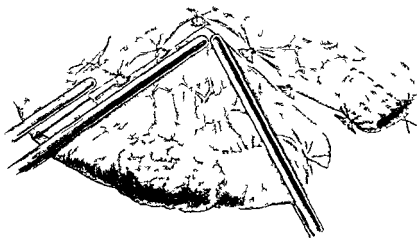


FIG 194 Enterectomy with end-to-side union. Three clamps are applied the distal end of the loop is crushed and tied. The mesentery is tied and the diseased loop is removed.

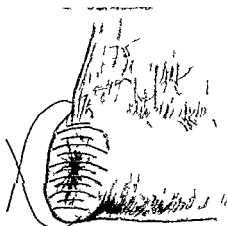


FIG 195 Enterectomy with end-to-side union. The distal stump is buried by a continuous sero-muscular suture picking up the mesentery which is thus drawn over the end when the ends of the suture are tied together.

bowel is crushed with forceps and then firmly tied with strong linen thread (see Fig 194).

When the clamps and ligatures are properly applied no bleeding occurs as the mesentery is divided a quarter of an inch in front of the row of ligatures. A pad of gauze is now placed through the mesenteric incision to prevent any soiling during the next stage.

The intestine is severed with a sharp knife just above the second clamp and one-sixth of an inch above the intestinal ligature, and the diseased part is thus removed without any spilling. The mucous membrane exposed at the remaining ends is cleansed with mops moistened with methylated spirit, and that above the ligature is removed with scissors. The lower stump is then invaginated with one or more continuous sero-muscular sutures of fine linen thread, as shown in Fig. 195. A clamp is then applied longitudinally near the free border of the distal intestine, with its point one inch below the blinded end. The two clamps are approximated, the anti-mesenteric border of the proximal intestine

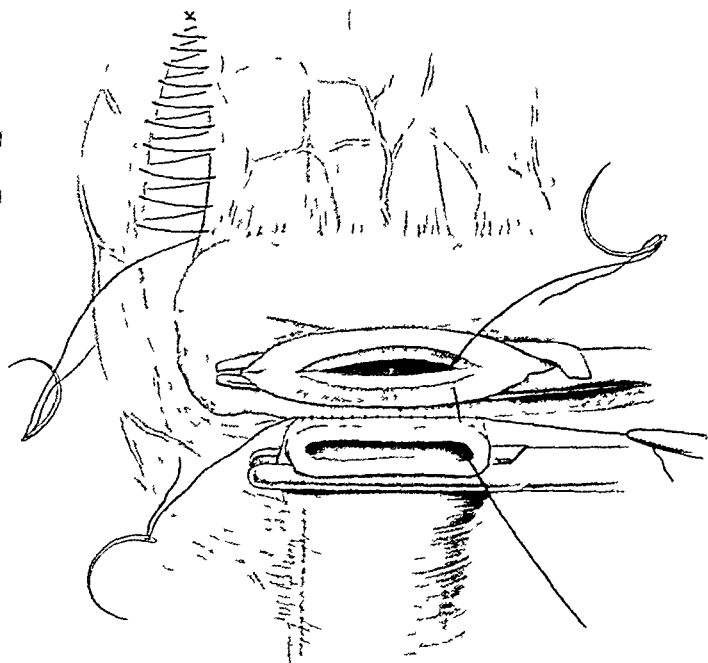


FIG 196 Enterectomy with end-to side union The open proximal end is joined to the side of the closed distal end, sutures are shown at the anastomosis and closing the mesenteric flap

being brought into contact with the lower part of the distal pouch. This prevents rotation and kinking of the proximal bowel. A sero-muscular suture is inserted to join the two pieces of bowel engaged in the clamps. Then an opening rather larger than the open proximal end is made in the pouch. The edges of the wounds are closed with a continuous suture, both knots being tied on the mucosa. The serous suture is now completed. Care is taken to obliterate the mesenteric gap of the proximal end. The clamps are removed and the serous suture is completed. The mesenteric incision is closed with a continuous suture (see Fig 196).

Enterectomy with Side-to-Side Union. Lateral union has been so successful in gastro-enterostomy that it has been frequently adopted

for intestinal anastomosis in preference to end to end union, over which it has the following advantages

(i) Leakage is less likely This is a matter of experience, but it was to be expected on theoretical grounds, for plane surfaces entirely covered with peritoneum can be brought together and the danger of the mesenteric gap thus eliminated

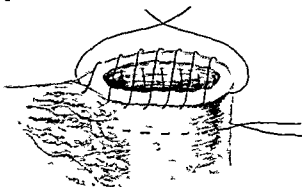


FIG 197 Another method of closing the end of divided bowel

(ii) The anastomotic opening is not limited in size and is not so liable to contract In this method there is some fear of leakage from the blinded extremities especially the upper one towards which peristalsis forces the intestinal contents, but great care in closing these ends and making a large anastomosis reduces this danger to a minimum



FIG 198 Enterectomy with side-to-side union

In dealing with the mobile small intestine there is usually no difficulty in getting the ends to overlap to the required extent, but in the large intestine this is sometimes impossible when an end to-end union can be made without tension For a satisfactory lateral anastomosis the ends must overlap about three inches, thus demanding about six inches more bowel than is required for end to-end union

Operation. The preliminary steps of the operation are the same as those described under End to Side Union When the mesentery has been tied and divided and a pack placed immediately behind the bowel, the

two ends of the loop of intestine are crushed and tied, and then divided between the ligatures and clamps which have been applied half an inch nearer the disease (*see* Fig. 194). The diseased part is thus removed without any appreciable spilling. The mucous membrane projecting beyond the ligatures is cleansed and removed with scissors, and each extremity is invaginated by two purse-string sutures, which also serve to bring the mesentery over the blinded end. These sutures are respectively half an inch and one inch away from the tied extremity (*see* Fig. 197). Intestinal clamps are then applied with their points at least an inch away from the blinded extremities. Each part included in the clamps is emptied as far as possible before the clamps are locked. The pouches are at least three inches long. Packs are carefully placed to isolate the pouches, and an anastomosis is made just as in gastro-jejunostomy, two continuous sutures being used (*see* Fig. 196). When the anastomosis has been completed, the mesenteric wound is closed with a continuous suture and all rough edges are buried as far as possible (*see* Fig. 198).

COLECTOMY

The general indications for resection of bowel have been discussed (p. 290). New growth, generally carcinoma,¹ is by far the commonest indication for colectomy.

CARCINOMA OF THE COLON

Diagnosis. As most of the subjects of carcinoma of the colon die from the local effects of their growth and not from dissemination, it is very important to diagnose and operate for this condition while the growth is still removable, and especially before the intestines become distended and damaged from increasing obstruction. Unfortunately, many patients do not seek advice until intestinal obstruction has developed. When a patient approaching or past middle age complains of constipation, perhaps alternating with occasional attacks of spurious diarrhoea with offensive stools, flatulent dyspepsia, griping pains, wasting and anæmia, a growth of the colon should be suspected, and the whole course of this bowel examined carefully. In this way a growth may often be discovered before distension develops. Rectal and bimanual examinations of the pelvis and of both loins may enable the surgeon to feel a tumour. Visible peristalsis is a very valuable sign, and gurgling at one spot may sometimes terminate a griping attack and indicate the probable site of the disease. The passing of blood and slime generally indicates that the growth is below the transverse colon. X-ray examinations, after an opaque meal or similar enema, may reveal and localise the obstruction. The sigmoidoscope is, however, by far the most reliable method of examining the part of the colon within its reach.

Vomiting may not occur until quite late, and then may herald the complete obstruction that is too often allowed to occur. In cases of doubt or of strong suspicion, an early exploration is strongly advised, for with early removal of the growth the prognosis is good. When an

¹ Corner and Fairbank have related a fatal case of secondary resection of a sarcoma of the colon, which had produced intussusception, in a boy aged 9. The growth was first noticed during the reduction of the intussusception about two months earlier. Only eleven cases of sarcoma of the colon were then recorded (*Pract.*, June, 1902)

operation is undertaken before obstruction develops the disease can be cured by a single operation, much time and trouble saved and repeated operations avoided

Indications for Resection. In deciding whether the growth is removable or not, the following *clinical* points are important

(a) *Local* The smaller the size, the more definite the outline and the more movable the growth, the more likely is it to be removable. Therefore mobility is of importance in pointing to the absence of adhesion. The absence of tenderness and the signs of inflammation are also important. When suppuration has occurred around the growth the dangers and difficulties of resection are greatly increased. Adhesion of the growth to the parietes is not so important because the adherent tissues can be excised with the growth. Adhesion and especially invasion of small intestine, stomach, pancreas or kidney are more serious, but may be met occasionally by careful separation or resection of a part of the invaded viscus. Signs of growth in the liver, especially nodular enlargement, ascites or nodules of growth felt on pelvic examination, indicate that the growth is inoperable. In many cases it is only possible to decide if a growth is removable after opening the abdomen.

(b) *General* Amongst the general points that must weigh with the operator are the strength and nutrition of the patients, their fitness to bear a severe operation and to supply the needful plastic repair.

Another point having a most important bearing upon the advisability of performing resection for malignant disease is whether this is complicated by *obstruction*, *tympanites*, etc. If there is one point which published (and still more the unpublished¹) cases prove, it is that the occasion in which it is right to submit a patient, the subject of intestinal obstruction, to such a prolonged operation as resection and suture must be of the very rarest. This is plain from the usual state of the patient in these cases and the conditions within the abdomen with which the operator has to deal. Is a patient, usually past middle life, whose strength and powers have been sapped for days or weeks by the nausea, inability to take food, vomiting, distension and all the distress which forms part of a misere of the later stages of chronic intestinal obstruction, in a fit state to go through a prolonged operation, and to supply after it the plastic repair which is needful for success? There can be but one answer here. And it is the same when we examine those local conditions which will have to be faced by the operator. The distension of the intestines and the difficulty of keeping them within the belly prolong the operation, add to the shock in an exhausted patient and, by rendering asepsis most difficult, diminish his chances still further. Another point, viz, the condition of the intestine above and below the obstruction, is a strong argument against resection and union of the intestine when obstruction is present. Above, the intestine will be distended, congested, softened and septic, below, empty and shrunken. The difference in the size of the two sections may prove a serious difficulty in their union, but a graver objection to uniting them now is the fact that, for the present, both are paralysed, and though this can be met, in a measure, by emptying the contents of the upper bowel by temporary cæcostomy, the condition of paralytic distension largely continues, with

¹ Quite as instructive in their way. *See also more*

its results—a continuance of toxic absorption; and if the contents of the intestine are passed on from above, too often they find the junction of the resected parts, made in softened, inflamed tissues, unfit to bear the strain.

Dr. Elliot¹ states that the mortality of primary resection and immediate suture in these cases is at least 50 per cent. even in the hands of the best surgeons. Peritonitis is the chief cause of death, and this is nearly always due to the fact that the most perfectly placed sutures or mechanical devices do not hold. Another cause of death is shock, partly due to an unnecessarily long operation. *Where obstruction is present, resection should be deferred until the obstruction has been overcome by one of the following means:*

(a) *Medical Treatment.* In some cases of impending or complete obstruction of the colon due to carcinomatous stricture, enemata may overcome the obstruction and tide the patient over his acute peril. Solid faeces blocking the stricture may be thus dislodged and the large collection of liquid faeces, and especially gas, evacuated. Soon the temporary inflammatory swelling round the stricture may subside. In this way cæcostomy and colostomy may sometimes be avoided and a cure made at one operation, to the great advantage of every one concerned. In grave cases, however, time must not be wasted in this worthy endeavour. If two enemata fail to act it is best to proceed at once to operation, for repeated purges and enemata are futile and dangerous.

(b) *Surgical Treatment.* (1) **Cæcostomy.** When the greatly distended cæcum can be recognised during peristalsis valvular cæcostomy is ideal. It can be performed very quickly, under local or general anaesthesia, and is attended with very little shock. When the patient is better of his acute obstruction further examinations can be made to locate the latter and perhaps a radical operation undertaken, the cæcostomy being allowed to close later.

As a general rule the secondary resection can be undertaken in anything from five days to three weeks after the preliminary operation.

When the diagnosis is uncertain it is necessary to explore the abdomen, for, although carcinoma is by far the commonest cause of obstruction of the large bowel, it should not be forgotten that other causes exist, such as volvulus of the cæcum or pelvic colon, intussusception, gallstones or enteroliths impacted in the pelvic colon, bands across the colon, notably at the splenic or hepatic flexure of the pelvic colon. Diverticulitis also may cause bands over or tubular stricture of the pelvic colon. It is also important to bear in mind that some forms of obstruction of the small intestine may be mistaken for obstruction of the colon; under these circumstances both the ascending and descending colon have been exposed and found empty, showing the need of careful exploratory laparotomy in most cases of intestinal obstruction of uncertain nature and site.

(2) **Colostomy.** In some cases colostomy may be more advantageous, as, for instance, when the growth is irremovable and permanent drainage is required, and also when there is much local distension above a removable growth in the pelvic colon. Under these circumstances the colostomy is made near the growth and it is subsequently removed with the growth and an end-to-end union made, a rubber tube being then passed from the anus.

¹ *Ann of Surg.*, 1905, xlii, 688.

through the anastomosis into the colon above, so that no over distension can occur to strain the union or cause a leak, abscess, peritonitis or fistula

(3) **Short circuit.** In some cases, with only moderate distension and no paralysis of the bowel, short circuit is more advantageous than either of the two methods already mentioned. A typical example is a case of growth completely obstructing the splenic flexure, where the middle of the transverse colon was joined to the pelvic colon. Later on the resection of the growth, with closure of the two ends near the anastomosis, was a comparatively simple and safe operation a good channel having been already established some weeks earlier. The patient was well over five and a half years later. With a cancer of the ascending colon ileocolostomy is better than cæcostomy or ileostomy because it leaves a cleaner field for the subsequent resection.

When a colic growth is irremovable a short-circuit, if it be practicable and safe, is far more satisfactory to the patient than either cæcostomy or colostomy, for he is saved the misery of having a permanent artificial anus.

(4) **Paul's Method** (p 318) This is very safe, but it is not often applicable except to growths of the pelvic colon and, sometimes, of the transverse colon. It does not allow a free resection of the mesocolon and its lymphatic glands but in spite of these objections, it has been followed by good results, immediate and remote.

ANATOMICAL AND PATHOLOGICAL POINTS

For the sake of convenience the large intestine is divided into several portions, and it is necessary briefly to state exactly the limits of the various portions.

The cæcum is only that part below the ileo cæcal orifice, the ascending colon is the part above this deeply placed in the loin and nearly always without a mesentery. It is about five to eight inches long, varying with the position of the cæcum and it extends upwards as far as the liver. The hepatic flexure is the abruptly bent portion extending forwards and to the left over the anterior surface of the right kidney and second part of the duodenum below the right lobe of the liver and the gall-bladder. It has no mesentery.

The transverse colon is a long and movable loop of colon, about twenty inches long, extending between the hepatic and splenic flexure. The length of its mesentery and the position of its central portion varies greatly. The splenic flexure is the acutely bent part lying deeply in contact with the tail of the pancreas, lower poles of the spleen and kidney. The descending colon is about five inches long and extends between the splenic flexure and the back part of the left iliac crest. It only occasionally has a mesentery.

The iliac colon, five to six inches long extends from the descending colon at the posterior part of the crest of the ileum to the front of the left psoas muscle at the side of the pelvic brim. It has no mesentery, but lies in contact with the iliac fascia. In the old text books this was described as a part of the sigmoid colon.

The pelvic colon, about sixteen to eighteen inches long extends from the iliac colon to the rectum, which begins opposite the middle of the

sacrum. It usually forms a long loop with a narrow base, and is so freely movable that its position varies a good deal. It usually lies in the pelvis, and first dips down along the left side of this cavity and then passes to the right and ascends and turns inwards to the middle of the sacrum. Its mesentery is attached along a curved line extending from the middle of the left psoas upwards and inwards to the bifurcation of the left common iliac artery, and then running downwards and inwards to the middle of the third piece of the sacrum.

The **rectum has no mesentery**, but is partly covered by peritoneum in its upper two-thirds, at first at the sides as well as in front, and lower only in front. It is only five to six inches long. In the old text-books the rectum was described as eight inches long and commencing at the left sacro-iliac joint. This clearly included the lower part of the pelvic colon.

Several points in the anatomy and pathology of the colon make resections here somewhat more difficult than in the small intestine.

(i) **The absence of a mesocolon and the resulting awkward position and immobility of certain portions of the colon**, especially the ascending and descending colon, used to hamper resections and union of these parts, but fortunately they can be mobilised by gauze dissection after dividing the reflections of the peritoneum extending outwards from them to the flanks. No important vessels are divided, for all these reach the colon on its mesial aspect.

In this way the diseased part can be brought outside the abdomen before the bowel is divided, and contamination of the wound avoided. Moreover, extensive resections can be made, and the bowel above and below united without tension. The large mesocolic space can be covered with peritoneal flaps and the bowel thus completely surrounded by peritoneum for end-to-end union if necessary.

The splenic flexure, especially if adherent to the spleen, kidney or flank due to inflammation round the growth, may be very difficult to free and deliver. Sometimes the hepatic flexure presents similar difficulties and may be adherent to the second part of the duodenum or to the pancreas. The gall-bladder, when adherent, may be removed with the growth.

A growth of the lower part of the pelvic colon often presents great difficulties, especially in the preservation of an adequate blood-supply to the rectum and in making a satisfactory anastomosis in the pelvis.

(ii) **The blood-supply of the colon** presents some difficulties which can be avoided by an accurate knowledge of the distribution and anastomosis of the blood-vessels. The ileo-colic artery supplies most of the lower six inches of the ileum, the cæcum, appendix and some of the ascending colon. The right colic is often a small and variable artery which supplies the ascending colon. It arises from the superior mesenteric just above the origin of the ileo-colic, but it often arises in common with or from the latter. The middle colic supplies the transverse colon and some of the hepatic and splenic flexures. The left colic supplies the descending colon, some of the splenic flexure and some of the iliac colon. The sigmoid arteries, of which there are generally two, supply the sigmoid loop and the iliac colon. The superior hæmorrhoidal supplies the pelvic colon and the upper two-thirds of the rectum. The ileo-colic, right colic, middle colic and sigmoid arteries anastomose fairly freely, so that the

division of one main trunk or several subsidiary branches need not lead to sloughing if the anastomosing arcades are not obstructed. But there is no arcade and but little anastomosis in the wall of the bowel between the sigmoid and the superior hæmorrhoidal arteries so that especial care is required in this locality. When tying the inferior mesenteric artery it is clearly safer to apply a ligature above than below the lower sigmoid

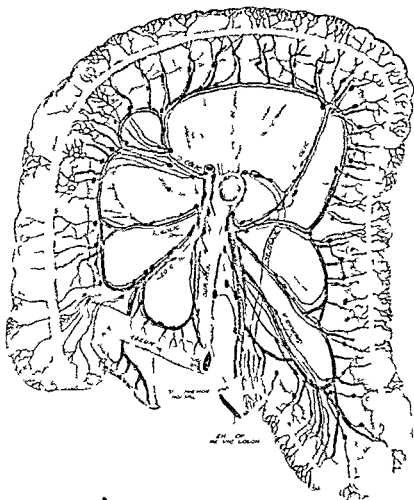


FIG. 199. Showing the arteries and lymphatic vessels of the colon. (Modified from Jamieson and Dobson.)

artery for then the nutrition of the lower part of the pelvic colon is much safer. When the ileocolic artery is tied the nutrition of the lower six inches of the ileum is compromised therefore this piece of bowel ought to be removed with the cæcum (see Fig. 199).

(iii) **The lymphatic drainage of the colon.** A knowledge of this is very important for the satisfactory radical operation for carcinoma of the colon which is by far the commonest indication for resection. Here,

as elsewhere, it appears necessary to remove the corresponding lymphatic vessels and glands in one piece attached to the primary growth. Jamieson and Dobson,¹ by their anatomical studies of the lymphatics of the colon, have placed our knowledge on a scientific basis, and pathological observations by Clogg² and others on the spread of carcinoma of the colon have added valuable information. On the whole the course of the lymphatic vessels draining any part of the colon corresponds with that of its main arteries, and the lymphatic glands are arranged as follows (see Fig. 199) :

(a) The epiploic in the appendices epiploicæ and upon the surface of the bowel. (b) The paracolic in the mesocolon and lying near the mesenteric border of the bowel. (c) The intermediate, lying upon the main blood-vessels about half-way between the spine and the bowel. (d) The main glands around the origin of the main artery.

As a rule the *intermediate* and especially the *main* groups of glands only receive lymphatic vessels from the more peripheral glands, but occasionally some vessels may run to them directly from the intestines, especially from the lower part of the colon.

The glands of the main group communicate freely with the central abdominal glands about the vena cava, so that if they are much enlarged and hard the prospects of permanent cure are not good; but many enlarged glands are only inflammatory, so that some caution is required in deciding whether resection should be undertaken. Theoretically all the four groups of glands should be removed with the primary growth, but less extensive resections have given good results because (1) glandular infection and dissemination are somewhat slow in carcinoma of the colon. This is especially true of annular growths of the pelvic colon, which soon cause obstruction and call for early attention. But softer and ulcerating growths which do not obstruct, notably those of the cæcum and ascending colon, have often infected the lymphatic glands extensively before they come to operation. (2) Whenever the intermediate glands are enlarged an attempt should be made to remove the lymphatic area with the primary growth. In the pelvic colon a more limited resection of the bowel and mesentery may be undertaken, especially in old and feeble patients, when the growth is early and the lymphatic glands are not enlarged. As carcinoma spreads by permeation along the lymphatic spaces in the wall of the bowel without obvious naked-eye evidence, as shown by Handley and Cole, it is necessary to remove at least three inches above and two inches below the growth. Mr. F. T. Paul,³ in his valuable address before the British Medical Association, makes the following very important remarks: "Cancer of the bowel is a disease which usually first threatens life by mechanically interfering with the functions of the alimentary canal. We need therefore to consider each case from the two sides, mechanical and pathological, and often it is necessary to direct our treatment to the relief of the mechanical obstruction before we can attempt a cure for the malignant growth. But whether we design to give relief only or to try to obtain a permanent cure, the selection of a particular operation is not merely a

¹ *Lancet*, 1907, i, 1137. *Proc. Roy. Soc. Med., Surg. Sect.*, 1909, ii, 149.

² *Lancet*, 1908, ii, 1007.

³ *Lancet*, 1912, ii, 217.

matter of clinical experience. The underlying malignancy and the pathological problems involved by it must not be lost sight of, and especially must we take into consideration the varying degrees in malignancy exhibited by cancerous growths in the bowel. On this rests the expectation of life in most of our patients when proper steps are taken to avoid a fatal issue by stenosis. We trust to our surgical instinct, combined with careful clinical investigation into the patient's constitutional condition, to guide us as to his fitness to bear an operation of a certain magnitude, but we must rely entirely on information obtained from pathological sources in estimating the real value of the operation and frequently in deciding its limits. Of what use is it to submit a patient to a long and dangerous operation if his prospect of life on recovering from it is little better than he would have obtained by a simple colostomy? Or, again, why undertake an extensive excision of mesentery for the removal of glands which in all probability are not infected? It is therefore of paramount importance that surgeons should familiarise themselves with the characters of the different kinds of cancer met with in various parts of the body as so much depends upon the behaviour to be expected from each kind. This is especially true of intestinal cancer. In no other part of the body is there a greater variation in the degree of malignancy than in the bowel."

Varieties of Cancer of the Bowel.¹ "The three varieties of carcinoma are (1) the large soft fungating 'encephaloid' type (2) the small hard 'scirrhus' type and (3) the infiltrating 'colloid' type. All may be said to be primarily columnar celled growths originating in the intestinal glands, and all ulcerate but they follow different paths of evolution, and attain different degrees of malignancy which it is important to recognise. The scirrhus variety is always unmistakable. It produces the hard ring stricture of the bowel and is more common than colloid cancer, but much less frequent than the soft fungating type. This latter may usually be easily distinguished from the colloid form of growth by the following characters. It is softer to the touch. There is a good deal of fungating growth within the bowel, but generally not much solid infiltration of the bowel wall. There are usually numerous large soft glands in the neighbouring mesentery, which are septic and not malignant. In colloid cancer, on the other hand, there is a hard edged ulcer with no fungation. There is dense hard infiltration of the bowel wall, often attaining a thickness of from one to two inches and giving it a solid feel. The glands, if affected, are not soft, but hard and glistening."

"Misconceptions exist regarding the nature of these different tumours. In the first place, some seem to forget that 'scirrhus' and 'encephaloid' are merely terms of clinical or macroscopic significance, convenient when properly used, but otherwise very misleading.

"The really important misconception, however, concerns the relative malignancy of the three varieties of cancer. Usually the big fungating, encephaloid type of growth is regarded as the most malignant, the colloid as being intermediate, and the scirrhus, or ring stricture, as the most benign. This arrangement is entirely wrong and out of accord with clinical experience. The colloid is the most malignant type, the

¹ *Paul, Lancet* 1912 ii, 217

ring stricture comes next, and the fungating type is the best—it being one of the least malignant kinds of cancer met with in the body.

“It is a clinical fact of considerable importance, to which I have often referred at our local medical society, that the up-growing forms of cancer are essentially less malignant than the down-growing, ulcerating, and shrinking types.

“The most common sites for the fungating type of growth are the rectum and cæcum, though it often occurs in the sigmoid, and occasionally at any other part of the large bowel. Colloid cancer chiefly selects the rectum, and ring stricture the sigmoid, though neither is limited to these regions.”

Influence of Pathology on Surgery.¹ “If a surgeon when operating takes the foregoing pathological details into consideration, they will often influence him considerably in his decision as to the nature and extent of the operation. Thus, if the growth be of the fungating type, recognised by its softness, bulk, situation, character of gland infection, &c., he would, on the one hand, feel justified in removing the tumour without necessarily interfering with any tissue much beyond the visibly affected area; or, on the other hand, if the risk to life seemed too great to allow of this being done, he would be encouraged to hope for a reasonably long period of relief by short-circuiting or colostomy. If the tumour prove to be massive and solid, and especially if there be evident glistening gland or peritoneal infection, or if the growth be in the rectum and can be felt as an abrupt hard-edged ulcer without fungation, then the case is one of colloid cancer, and the outlook would be recognised as discouraging. When a wide and thorough removal appeared warranted it might be undertaken; but as the prospect is never good in colloid cancer, either for excision or temporary measures, less risks to life should be accepted. In the case of ring strictures, always easily recognisable, the indication is to excise more widely than one used to think necessary, and to remember that it is in this type of growth we have the best reasons for following up the path of lymphatic infection.”

OPERATIONS

(1) **Paul's² Operation.** In honour of Mr. Paul's long and valuable experience and very successful results, I venture to quote his remarks and description in full:

“I did my first colectomy by the glass tube method just twenty years ago. At the time of publishing it³ I narrated six other cases to show how this method had been led up to by previous unfavourable experience with primary suture and buttons, which proved to be accompanied by a heavy mortality. Since 1892 I have adhered to the same technique, and with very good success. Only at one period, when I imagined I had become clever enough to obtain primary union, did I abandon the tubes and go back to suture. I did one case in this way at the infirmary and one in private practice. Both died, the latter being the only fatal case in the Table, and the former sharing this unenviable distinction with only one other patient. No doubt the time

¹ Paul, *Lancet*, 1912, ii, 217

² *Lancet*, 1912, ii, 224.

³ *Liverpool Med.-Chir. Journ.*, 1895.

will come when a better method than bringing out the ends of the bowel and draining them by means of glass tubes will be invented, but I doubt if I shall ever again excise tumours of the colon in any other way, as I know this can be undertaken with a very low mortality. The operation is not a pleasant one for the patient, and the cure is delayed, but the final result is good and after all, that is what should appeal most to us and to our patients.

"Very shortly I will describe the original operation again. In most cases the tumour will have been located before it is undertaken. If not, a preliminary incision in the middle line below the umbilicus will

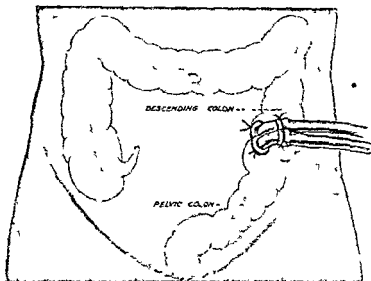


FIG 200 Paul's method of resection of carcinoma of the colon. The growth is removed, and two Paul's tubes are tied in. The spur is destroyed later.

be necessary, and usually this will not be suitable for the removal of the growth. One needs an incision about six inches long, conveniently placed over the position of the bowel to be excised. Having made this, and packed off the neighbouring viscera, the bowel is loosened from its attachment to the neighbouring parietes by an incision in the parietal peritoneum, especially in the caecal and sigmoid regions. By means of an aneurysm needle the mesenteric vessels are then ligatured on the proximal side as far as the character of the glands or size of the tumour indicate to be necessary, and they are clamped with compression forceps on the distal or bowel side. Upon cutting through the mesentery between the ligatures and the forceps the fold of bowel, usually about a foot in length, is completely loosened, and now hangs out of the abdomen. The cut in the mesentery is sutured with catgut and the two portions of bowel for about four inches beyond where they are to be cut across are also lightly sutured to each other, so that they lie together like the barrels of a gun. This arrangement is carried out in order to render the subsequent clamping of the spur safe from risk of perforation. Next, two intestinal glass drainage tubes are ligatured into the bowel, one above

and the other below the growth, and the affected part is cut away. The exposed mucous membrane round the tubes is cleansed and dried. The abdominal wound is sutured, and the ends of the silk ligatures round the tubes are passed through the skin to fix the latter securely. Then the stumps of bowel are covered with xeroform powder, the distal tube is plugged with wool, and a thin rubber tube is attached to the

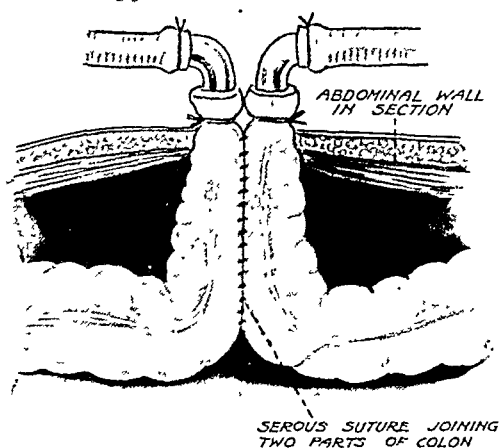


FIG. 201A. Paul's method of resection of carcinoma of the colon. The two stumps are drained and also sewn together for four inches, so that no small intestine can come into the grip of the enterotome when the spur is being destroyed.

proximal to carry off fæcal matter. Done in this manner the operation is almost bloodless, and the shock inappreciable (see Figs. 200, 201A and 201B).

"The tubes remain in for from five to ten days, and the wound takes from three to four weeks to clear up. Then a strong clamp of Dupuytren type is introduced and the long spur is clamped (see Fig. 201B). This requires two days, and the healing of the clamped edges will occupy

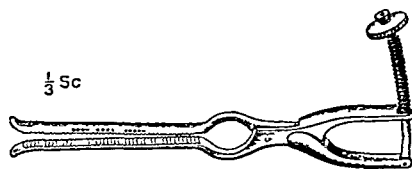


FIG. 201B. Paul's clamp for destroying the spur.

a couple of weeks. Finally, the mucous membrane is separated from the skin, without opening the peritoneal cavity, and sutured with catgut; the skin is brought together with deep mattress sutures . . . which must be retained for some time as leakage with secondary union is perhaps more frequent than primary union. . . . I have had the operation completed in the infirmary in a month, but it is a mistake to rush the various stages, and I now always tell my patients it will take quite two months to complete the operation, and that it will be three months before they can expect to be fit for work again.

It might be assumed that bowel excised by bringing out the ends and restored by clamping the spur and suturing the opening without detaching it from its surface connections would differ considerably from the normal and be subject to stricture. Yet this has never occurred in any of my cases and I have not been called upon to do any further operation to improve the condition of the bowel. On the contrary I once saw the bowel five years afterwards when operating for another trouble and in this patient I could not have told that it had ever been touched at all. The entire sigmoid had been removed for gangrenous volvulus and the ends brought out and clamped as described. On looking at the part I found neither stricture nor adhesions nor indeed anything to suggest that such an operation had been done. The patient was a young lady 25 years of age. It may I think be safely assumed that no inconvenience will follow this operation when once the artificial anus has been satisfactorily closed.

(2) **Resection with End to end Union** In the absence of obstruction and after careful preparation this method can be carried out with safety and satisfaction. Preliminary cæcostomy colostomy or short circuit is essential in cases of acute upon chronic intestinal obstruction and cæcostomy colostomy or a tube reaching from the rectum up through the anastomosis to prevent gaseous and faecal distension adds to the safety of patients not suffering from definite obstruction at the time of the resection.

Direct simple suture in two layers applied with care and cleanliness is a safe and simple method not likely to go wrong in any way because it secures direct apposition good lumen and certain hæmostasis—attributes which some of the so called aseptic unions lack.

End to-end union is more physiological than lateral anastomosis and is not cursed with the probable dilatation inflammation and rupture of a blind end—which are common sequelæ of lateral anastomosis. Moreover it is less profligate or wasteful of the colon and in my experience is safer than lateral union provided that care be taken to divide the bowel obliquely in order to preserve a generous blood supply to parts to be united.

Excision of the Cæcum and Ascending Colon with the Corresponding Lymphatic Area This extensive resection is usually the best for carcinoma anywhere in this part of the intestine for not only is it more radical than any other method but it is also easier and safer the blood supply of the parts to be joined together can be more certainly preserved and the sewing can be done outside the abdomen and therefore with greater ease and security and with less risk of infection. This method is also applicable to certain cases of tuberculosis or other non malignant disease limited to this part of the intestine especially when the ileo-colic group of glands are infected. Jamieson and Dobson¹ having found from their careful research upon the lymphatics of this part that an operation for carcinoma to be radical must remove all the ileo-colic group of lymphatic glands reaching as high as the duodenum suggested such an operation in detail. In the operation the bowel well wide of the disease the lymphatic vessels and primary lymphatic glands are removed *en masse*. Hitherto surgeons had been content to remove some of the lower ileo

¹ *Lancet* 1907 i 1142

colic glands, but F. S. Bird¹ had described an operation more radical than the one usually adopted at that time. More than thirty years ago, Mr. Lawson, of Hull,² mobilised the ascending colon after dividing the parietal peritoneum to the right of it, and removed the lower six inches of the ileum, cæcum, and greater part of the ascending colon together with some enlarged glands. The patient, aged 33, made a good recovery.

Later, Mr. Dobson³ successfully performed the operation, and I venture to quote his excellent description taken from the notes written by Mr. L. R. Braithwaite, then resident surgical officer, who assisted.

Operation. "An incision⁴ seven inches long was made in the right linea semi-lunaris, the tumour in the ascending colon was defined, and the small intestine was packed off to the left side of the abdomen. The duodenum and the ileo-colic vessels were then defined, the overlying peritoneum was divided, and a fairly large uppermost gland of the ileo-colic chain was pushed downwards. The artery and vein were then clamped and divided, the ligature being applied about half an inch from the superior mesenteric artery. At this stage clamps were applied to the transverse colon close to the hepatic flexure and to the ileum about six inches from the ileo-cæcal valve. The peritoneum on the outer side of the ascending colon was then divided and the whole mass, ascending colon, cæcum, and terminal portion of the ileum, was thrown over to the left, the peritoneum, ileo-colic vessels, and chain of glands being stripped up to the duodenum; the ureter was seen and avoided and some vessels were tied. The mesocolon was then divided from the duodenum to the selected point on the colon, some branches of the middle colic artery being tied. In the same way the peritoneum of the anterior layer of the mesentery was divided down to the ileum and also the posterior layer, and the terminal branch of the mesenteric artery was secured. The whole mass was now easily withdrawn from the abdomen and the colon and ileum were divided between clamps; both ends were closed by celluloid thread continuous suture, three layers in the colon and two in the ileum. Lateral anastomosis between the two portions of gut was now effected, thus drawing up the mesentery and covering in the denuded area on the posterior abdominal wall. A small tubular drain was inserted through a stab wound in the loin and the anterior wound was closed in the usual way."

It is an advantage to elevate the right side of the body during this operation, so that the small intestine may cause less embarrassment. I prefer to make an end-to-side union, joining the obliquely divided end of the ileum to the side of the transverse colon about two inches from the closed extremity of the latter. This makes a very good anastomosis without trouble from the disparity in size of the large and small intestines and, above all, without fear of dilation of the blind end of the ileum left by a lateral anastomosis—a common source of danger. A flap of the great omentum is sewn over the anastomosis for greater safety.

A similar operation is often required and is very successful for tuberculous disease limited to this part of the intestine.⁵

¹ *Lancet*, 1906, i, 440.

² *Lancet*, 1893, i, 618.

³ *Lancet*, 1908, i, 149.

⁴ Morison's incision running obliquely downwards and inwards is much better, giving better and more direct exposure as well as a sounder abdominal wall.

⁵ French, Rowlands and Poulton, *Guy's Hospital Reports*, 1911, lxx, 265.

Excision of the Hepatic Flexure Growths at or near the hepatic flexure unless quite early are somewhat difficult to remove satisfactorily. The anatomical fixation of the bowel can be overcome by mobilisation as already described but pathological adhesions are apt to cause more



FIG. 202. Excision of the right colon for carcinoma. The cæcum and inches of the ileum and some of the transverse colon are generally removed at the same time to make the operation more radical and the anastomosis easier and safer. The colon is mobilised as shown in the figure and brought out of the wound before the ileum and transverse colon are divided.

trouble especially when the right portion of the transverse colon is short. Adhesions to the duodenum and pancreas are especially troublesome and may make it impossible to get well beyond the disease without grave injury to these vital structures. Therefore early recurrence is not uncommon.

The lymphatic drainage is chiefly along the course of the right division and trunk of the middle colic artery, so that in early cases it is necessary to remove the right half of the mesocolon and tie the right division of the mesocolic artery. Later cases may require the removal of the greater part of the transverse mesocolon with division of the mesocolic artery itself. Then the greater part of the transverse colon has to be removed, for its nutrition is entirely dependent on the left colic artery. In many cases such an extensive resection can be avoided by removing the glands and lymphatic vessels from the mesocolic arteries by gauze dissection after incision of the lower leaf of the mesocolon. After wide resections

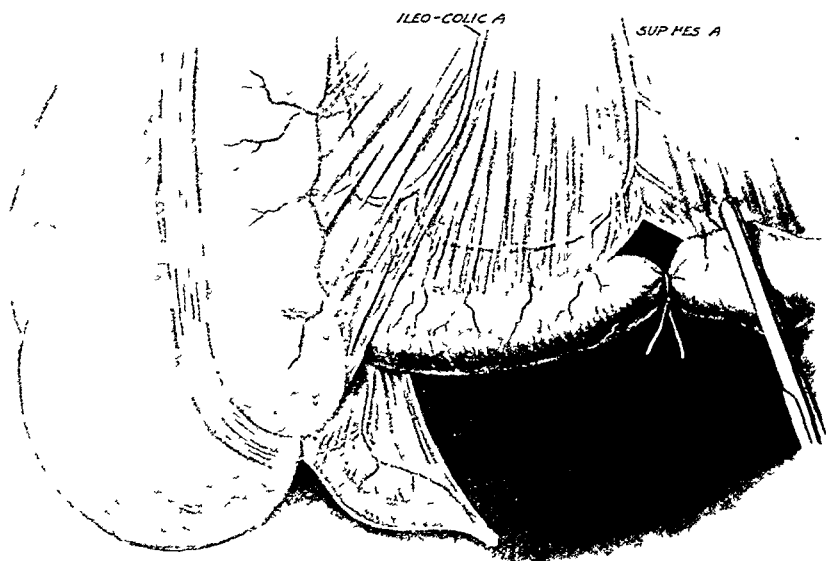


FIG. 203. Excision of right colon. When the part to be removed has been brought outside the abdomen, the ileum is divided opposite the bifurcation of the inferior mesenteric artery. The distal end is tied but not invaginated.

here, certain difficulties arise in restoring the channel, for in spite of mobilisation it is not easy to join the lower part of the ascending colon to the middle or left third of the transverse colon.

Closing the two ends is not satisfactory, for, with lateral ileo-colostomy, faecal matter still enters the cæcum and may cause trouble at the closed end of the colon, especially if the ileo-cæcal valve is efficient. End-to-side ileo-colostomy is unsuitable, for this either leaves a closed pouch consisting of the end of the ileum, cæcum and some of the ascending colon, or a portion of bowel requiring permanent drainage of mucous secretion. It is therefore clear that, when extensive resection is necessary, it is better to remove the cæcum and ascending colon as already described and then to join the mobile ileum, about six to ten inches from its termination, end-to-side, to the middle or left third of the transverse colon or, what is more suitable in some cases, to the pelvic colon. This plan has the additional merit of allowing a much freer removal of the bowel above and below the disease, and of the ileo-colic glands, some of which may be infected. It is right to say, however, that early and local resections have

been successful thus Sir George Makins¹ had one patient alive and well at the end of fifteen years and one survived four years before a recurrence took place.

Excision of the Transverse Colon Growths of the transverse colon may be felt early but they are not very favourable for resection for (1) the mesocolon is often fat short vascular and invaded by growth (2) the lymphatic glands of this part are not easily removed After adequate resection union is difficult without free mobilisation of the colon The growth and three inches of bowel on either side of it together with a corresponding wedge of mesentery and the paracolic and intermediate

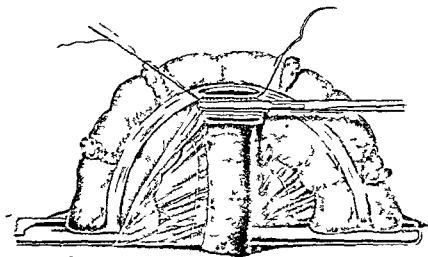


FIG. 204 End-to-side anastomosis of ileum to transverse colon The opening in the colon is shown too near the sero muscular suture

glands are removed the main trunk and generally the right branch of the mesocolic artery being saved In some cases only the arterial arch between the mesocolic and left colic arteries has to be divided (Fig. 199)

Excision of the Splenic Flexure This may be very difficult for this part of the colon is highly and deeply placed and tethered by the short and thick costo colic ligament Above all a growth here may become adherent to the spleen stomach or kidney Moreover some of its lymphatics drain into the splenic lymphatic glands Late growths here and in the transverse colon may ulcerate into the stomach causing distressing fecal vomiting It is difficult or impossible to feel an early growth here and even when the distended abdomen is opened for intestinal obstruction it is not easy to reach and feel a growth in this situation but distension of the transverse colon is a stimulus to further search The lymphatic drainage is along the left side of the mesocolon and the ascending branch of the left colic artery and calls for the removal of about a third of the transverse colon and the upper four inches of the descending colon

¹ Burghard's *Operative Surgery* 1914 461

Operation. Access is best obtained through an oblique and long incision in the left flank running downwards and inwards from below the tip of the eleventh rib to the outer border of the rectus abdominis and parallel with the intercostal nerves which are thus saved, with great advantage. The external peritoneal reflection of the descending colon is divided and the incision is carried upwards until the costo-colic ligament is divided. The colon is mobilised by gauze dissection and drawn inwards. The left part of the gastro-colic ligament is divided. There may be considerable difficulty in separating the growth from the spleen, stomach or left kidney. When it has been freed, the growth is delivered

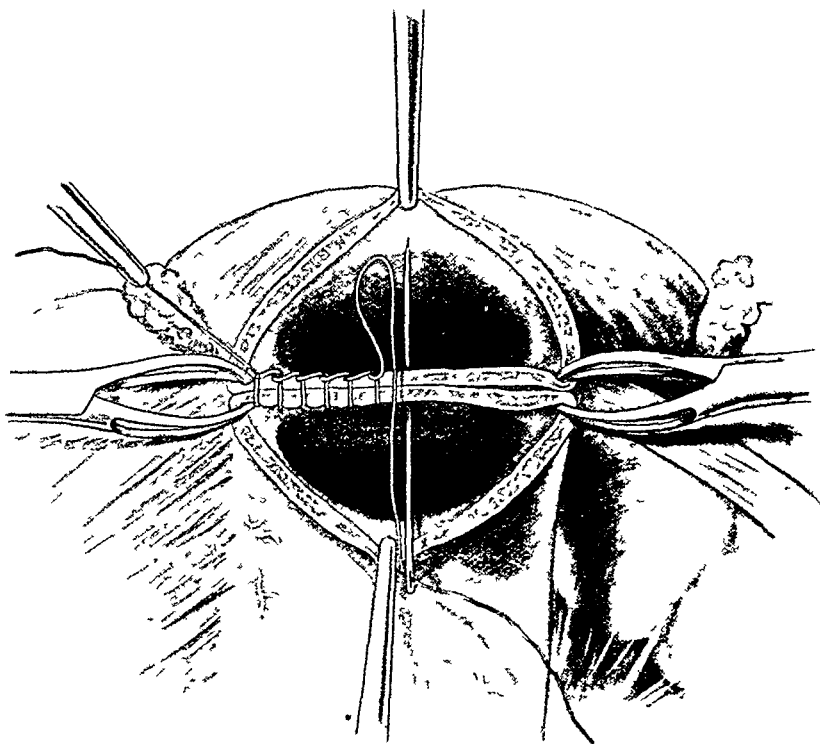


FIG. 205. End-to side anastomosis of ileum to colon The deep or button-hole suture is shown.

and removed in much the same way as already described under removal of the hepatic flexure. The transverse colon is joined to the mobilised descending colon by end-to-end union. Growths of the descending colon are less common, and are treated in a similar way, the main secret of success depending on free mobilisation of the bowel above and below, so that the cut ends can be easily approximated.

Excision of the Pelvic Colon. Carcinoma is far more common here than anywhere else in the large bowel except the rectum, and in the majority of cases it is of the small annular variety. Clogg, in eighteen autopsies, found enlarged glands in eighteen, but these were in close proximity to the growth in all except six, and in three of these there were enlarged glands on the inferior mesenteric trunk or even higher.

In only two thirds of the cases were cancer cells found in the enlarged glands. These facts, and the long mesentery almost invariably present make growths of this part unusually favourable for removal. Even limited resection of the growth, small lengths of bowel above and below with a small portion of the mesocolon have been attended with good results but there is little doubt that wider resections are likely to improve the results. Jamieson and Dobson,¹ Moynihan² and Kummel³ advocate wide resections with more extensive removal of the lymphatic area.

It is most important to realise that when necessary very extensive resections can be rapidly and successfully carried out after the descending, iliac and pelvic colons and the splenic flexure have been freely mobilised.

Operation. The surgeon stands on the left of the patient and makes a long incision an inch to the left of the middle line and extending from a little above the umbilicus to the pubis. The rectus fibres are drawn out and the peritoneum is opened sufficiently to admit the hand which after feeling the growth is immediately passed upwards to examine the upper and lower surfaces of both lobes of the liver. Nodules of growth felt here indicate that resection must be abandoned. The lumbar glands are palpated and the pelvic peritoneum is examined and if no growths or extensive adhesions are felt the resection is commenced.

The Trendelenburg position is adopted, the peritoneal incision is enlarged and the edges of the wound are protected with large enveloping pads of gauze which are maintained in position by the blades of suitable self-retaining retractors. The small intestines and cecum are packed off with large and long moist gauze rolls secured at the outer ends. The glands along the inferior mesenteric artery are examined and an incision is made through the parietal peritoneum about an inch to the left of the descending colon and this incision is carried both upwards and downwards to the extent required for the free mobilisation of the colon care being taken to avoid injuring the spermatic vessels. These and the ureter are left behind but sometimes the blood vessels are inseparable from the growth and have to be removed with it. The ureter being much further in is rarely adherent (see Fig. 202). The colon is rapidly mobilised by gauze dissection and without appreciable loss of blood. The blood vessels are now examined and an incision is made through the mesial leaf of the mesocolon over the inferior mesenteric artery below the origin of the left colic artery. This is continued downwards and to the left towards the sigmoid loop and the glands with the loose connective tissue bearing lymphatic vessels are separated from the artery from above downwards by gauze dissection. If it becomes evident as the dissection is progressing that the growth cannot be satisfactorily removed without dividing the inferior mesenteric artery and vein these are tied and divided above the origin of the lower sigmoid artery. In most cases it is not necessary to divide the inferior mesenteric trunks and only the sigmoid vessels need division near their origin. Sometimes only one of these and some of the branches of the other have to be divided. The sites for section are now selected at least three inches above and two inches below the growth, and clamps and stout ligatures are applied

¹ *Lancet*

² *Surg. Gynaecology and Obstetrics* May 1909

³ *Arch. f. Klin. Chir.* 1899 1 x 5, 5

above and below each of these points after emptying the bowel between (see Fig. 206). The mesentery is divided to the required extent, the loop is brought outside the abdomen, and moist gauze packs are placed behind and around it. The intestine is then divided between the clamps and the ligatures and removed. The remaining ends should project about an

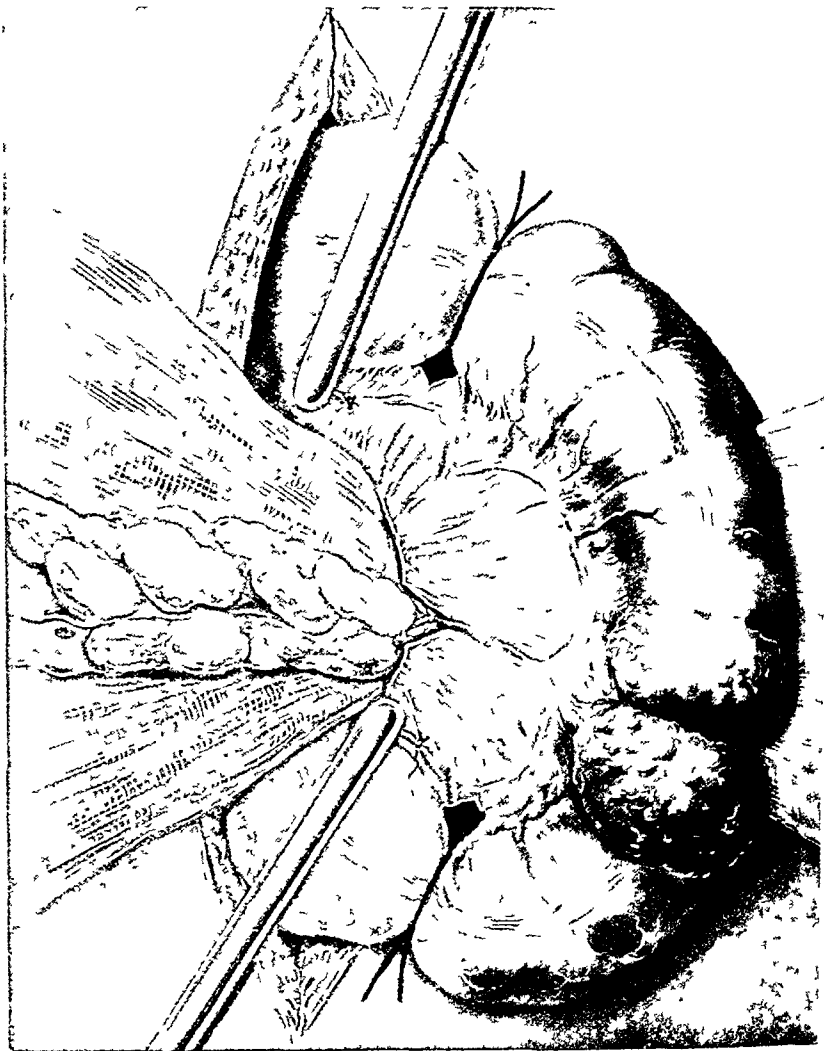


FIG 206 Excision of carcinoma of the pelvic or sigmoid colon. The glands are cleared off the inferior mesenteric vessels and brought out with the primary growth

inch beyond the clamps. They are cleaned with gauze swabs moistened with methylated spirit. If the bowel has been sufficiently mobilised the ends can be brought together with ease and they are joined with two continuous sutures as already described under End-to-End Union (see Fig. 207). Especial care is required to obliterate the mesenteric gap, and some of the appendices epiploicæ may be tacked over the line of union. When the clamps are removed a little bleeding may occur from the

mesenteric arches close to the bowel. These points are tied and the mesenteric incision is closed with a continuous catgut suture. The bowel is wiped with moist swabs and replaced in the abdomen after all picks have been removed. The Trendelenburg position is abandoned, and the abdomen is closed in layers in the usual way. Drainage is rarely necessary and tends to interfere with perfect union. If any contamination of the retro peritoneal cellular tissues has unfortunately been allowed to occur or persistent oozing takes place from inflamed surfaces a tube

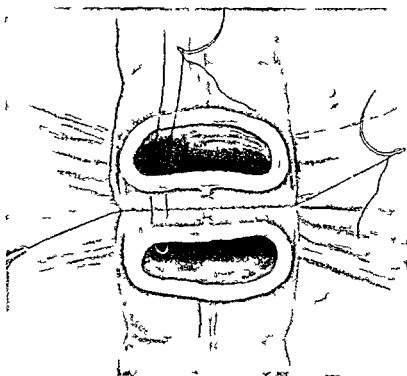


FIG 707. Excision of carcinoma of the pelvic colon. The mesenteric space is obliterated with peritoneal flaps and sutures and an end-to-end union is made with two continuous sutures beginning at the side of the bowel.

may be introduced through a stab wound in the flank and left for forty-eight hours. The following example is interesting and remarkable in several ways.

Dr M., aged 48, is one of nineteen children. His father and one brother died of cancer of the bowel. He himself had suffered for years from piles from which bleeding had often occurred. For the last two years there had been a good deal more bleeding from the bowel and this had been often associated with pain in the left iliac region. In March 1910 the bleeding became more severe and came on quite apart from defecation. He gradually got into poor health and wasted a good deal and a fortnight ago he fainted. Mucus and much blood escaped from the rectum. The patient saw several consultants and was referred to me for operation on October 19, 1910.

I felt an elevated growth high in the rectum. I could not find any stricture but only what appeared to be an ulcer occupying one side of the bowel. During the examination the growth receded out of reach, clearly showing that it was fairly

high in the bowel, but had intussuscepted into reach. Then the receded growth could be felt through the anterior wall of the rectum. It was thought that an abdomino-anal resection would be the best operation.

The bowels were well cleared out and the patient was kept at rest for three days and carefully prepared on a diet leaving little residue. Morphine grain $\frac{1}{2}$ and atropine grain $\frac{1}{150}$ were injected an hour before the operation on October 22, 1910, and axillary saline infusion was also commenced and continued during the operation. Five pints in all being given. Open ether was administered by Mr. Plumtre. The abdomen was opened through the lower and inner part of the left rectus, and the growth was at once found in the lower part of the sigmoid loop about nine inches from the anus. It was freely movable, and some enlarged glands were felt in the meso-sigmoid. The liver and lumbar glands were normal. The high Trendelenburg position was adopted, and it was decided to resect the growth abdominally and join up the colon end to end. This was carried out as described above, nine inches of bowel and the lymphatic area being removed. Microscopic examination of the enlarged glands showed inflammatory changes only. End-to-end union was performed with two silk sutures. The first was a continuous Connell, and the second a continuous Lembert suture. The packs were removed and the rent in the mesentery was closed as far as possible with catgut sutures, and the bowel was replaced. The peritoneum was cleansed of blood, and the wound was completely closed in layers. The operation lasted an hour and a quarter, and at the end of it the patient was not collapsed. On opening the piece of bowel removed it contained no faecal matter, only a little blood-stained mucus. An ulcer two inches long and one and a half inches wide with rampart-like edges was seen; the mucous membrane around it was much congested and inflamed. The ulcer did not encircle the bowel or appreciably narrow the lumen; it had clearly obstructed and caused pain only by intussusception. There were very few enlarged glands in the mesentery, except quite close to the growth, which was a columnar-celled carcinoma.

The patient did very well, the wound healed without any trouble, and he left the home within a month. He was at work in his busy practice within two months of the operation. He remained well for thirteen years, and then died of an acute abdominal catastrophe—probably ruptured duodenal ulcer.

A similar operation is usually the best treatment for chronic inflammatory affections of the colon causing chronic obstruction. Tumour-like masses may form as a result of inflammation of diverticula of the colon. This disease may affect any part of the bowel, but it is common only in the iliac and pelvic colon (*see* p. 414).

Resection with reunion of the lower part of the pelvic colon and pelvo-rectal junction is very difficult, and is fully described under cancer of the rectum in Chapter XXVIII.

Results of Colectomy. Colectomy is a formidable operation and is usually called for in elderly patients who are exhausted by chronic intestinal obstruction. The immediate mortality therefore is high and is likely to remain considerable in spite of improvements of technic. In no large series is the mortality under 10 per cent. The ultimate results, however, are much more satisfactory and are likely to improve with earlier and more radical operation.

Mr. Paul¹ says: "I have undertaken colectomy on eighteen private patients during the last ten years, 1901-1911. Only one died—the patient in which I foolishly attempted primary suture, an otherwise favourable case of malignant growth in the transverse colon. The remaining seventeen were done by the glass tube operation, and all recovered, though some of them were advanced in years. Among the most interesting points noted in the Table is the long survival of patients who have been operated on for cancerous growths. Of the seventeen

¹ *Loc. cit.*

cases three were non malignant and fourteen cancer. Of the latter eight are still living and not known to have recurrence, two have died from apoplexy, and four have died from recurrence at two and a half, three and a half, three and a half, and seven years respectively. It would be difficult to find another group of cancer cases showing such a satisfactory result. I certainly could not match it in any other branch of my work. Beyond the ten years I know of several cases living and well, but thought it undesirable to complicate the matter by reference to patients outside the period selected.

"Summary of colectomy cases. All cases operated on in private practice, 1901 to 1911. 18 cases, 6 males, 12 females.

"Mortality. 1 death (primary suture), 17 recoveries (glass tube operation).

"Situation. Cæcum, 7, sigmoid, 8 (3 volvulus), colon, 3.

"Age. 20-30 (2), 30-40 (2), 50-60 (8), 60-70 (5), 70-80 (1).

"Life after operation—non malignant. all living, 3, 9 and 10 years. Malignant. 8 living, $\frac{1}{2}$, $1\frac{1}{2}$, $2\frac{1}{2}$, 3, $3\frac{1}{2}$, 6, $7\frac{1}{2}$, $7\frac{1}{2}$ years, died, recurrence, $2\frac{1}{2}$, $3\frac{1}{2}$, $3\frac{1}{2}$, 7 years, died, apoplexy, $\frac{1}{2}$, $2\frac{1}{2}$ years."

R. T. Miller, Jr.,¹ in a valuable contribution, analysed the 129 cases of cancer of the colon admitted to the Johns Hopkins Hospital between 1889 and 1919. There were seventy resections with twenty four deaths, a mortality of 35 per cent, but since 1919 there were fourteen resections with only one death. Lateral anastomosis was more dangerous than end to end union, and resection of the left than of the right colon. The greatest mortality attended the removal of growth of the transverse colon and splenic flexure. Twenty eight per cent of those patients who recovered after resections were well five years afterwards. Lockhart Mummery² recorded twenty six cases of resection of carcinoma of the colon with six deaths, a mortality of 23 per cent. Six died of recurrence, four of them within a year of the operation.

COMPLETE COLECTOMY

This severe and extensive operation is very rarely required, although it was frequently performed some years ago for chronic constipation or chronic intestinal stasis, it is no longer performed for this condition because the ultimate results were not satisfactory.³

Indications. (1) Severe and intractable colitis when the rectum and lower part of the colon are healthy. It is unfortunate, however, that the disease generally extends into these parts, moreover, in these cases adhesions and the poor general condition of the patient make the operation difficult and hazardous. If the cæcum and rectum are normal, an anastomosis between these parts is much safer and is efficient (see p. 370). When the cæcum is involved the ileum can be joined to the lower part of the pelvic colon or rectum, if these are healthy. The ileum may be divided about six inches from the cæcum, the proximal end being implanted into the pelvic colon and the distal end either closed or brought to the skin so that the colon can be irrigated. Failing relief in one of these ways a secondary colectomy may be performed.

(2) Idiopathic dilatation of the colon (Hirschsprung's disease), when other and less severe methods have failed.

¹ *Ann. of Surg.*, 1923, lxxviii, 209.

² *Diseases of the Rectum and Colon*, 1923, p. 776.

³ Chronic constipation was fully discussed before the Royal Society of Medicine (*Proc. Roy. Soc. Med.*, 1913, vi, R.S.M. Dis., p. 1, and 1921-22, xv, *Sec. Proctol.*, p. 51).

Operation. After careful preparation of the patient for several days and evacuation of the colon by several enemata a long left paramedian incision is made extending from two inches above the umbilicus to the pubis. The cæcum and the lower end of the ileum are held forwards by an assistant while the parietal peritoneum, just below and to the right of these structures, is divided by a blunt-pointed pair of scissors. Once an opening is made in this membrane two fingers are introduced to lift it, while the incision is extended upwards (without danger or appreciable hæmorrhage) as far as the hepatic flexure and inwards below the lower six inches of the ileum; the ileum and the cæcum are then rapidly mobilised by gauze dissection, the right ureter being pushed backwards and carefully protected. The right mesocolon and the lower part of the mesentery of the ileum are then divided between ligatures close to the bowel. It is important to tie the vessels firmly with stout linen thread, otherwise they may retract and cause severe bleeding. In dealing with the hepatic flexure great care is necessary to avoid injuring the duodenum and pancreas. The transverse colon is drawn well forwards by an assistant, while the vessels in the gastro-colic omentum and mesocolon are tied and divided between ligatures as before. It is wise to tie the membranes separately and close to the bowel, for the vessels of the transverse mesocolon are large and difficult to secure satisfactorily.

The splenic flexure, which is usually high and very adherent, is mobilised by dividing, and later tying, the parietal peritoneum and adhesions on its outer side, care being taken to avoid injuring the mesocolon. Once this part has been liberated the colon is drawn downwards and forwards, and the parietal peritoneum, to the outer side of the descending colon, is divided and the descending, iliac and upper part of the pelvic colon are mobilised. The vessels of these parts are then firmly tied and divided between ligatures. The ileum, six to eight inches from its termination in the cæcum, is divided between two clamps and the pelvic colon, a little below its middle, is similarly treated; an end-to-end union is then made between the ileum and the pelvic colon. Both the ileum and colon are divided obliquely so that more of the ante-mesenteric border is removed and the parts to be joined are thus well supplied with blood. The section of the ileum is more oblique than that of the colon owing to its smaller size. The union is made in the usual way with two continuous sutures, one of fine linen thread piercing all the coats and the other a Lembert or Cushing suture of fine catgut. The mesenteric gap between the end of the ileum and the pelvic colon is carefully closed with continuous catgut sutures in order to prevent loops of small intestine travelling downwards behind the anastomosis into the pelvis, a complication which may be attended by volvulus or kinking with troublesome symptoms of obstruction or of irritation of the bowel. Any raw places where the mesocolon and mesentery have been divided are carefully sewn and covered with peritoneum. It is an additional safeguard to pass a large rectal tube from the anus upwards through the anastomosis into the ileum for six inches. The introduction of this tube is facilitated by running several ounces of paraffin through it into the rectum by means of a Higginson's syringe.

CHAPTER XVI

ACUTE INTESTINAL OBSTRUCTION

THE grave urgency of this condition is not yet sufficiently recognised. Our chief hope of lessening its appalling mortality is in earlier diagnosis followed by immediate operation. Therefore I think it vital to discuss the diagnosis here.

Symptoms and Signs. (a) *Pain* The initial pain of acute intestinal obstruction is usually severe especially about the umbilicus. When the obstruction is in the small intestine there is often great pain in the back. Later the abdominal pain is of a colicky nature and it is often accompanied by visible peristalsis and followed by vomiting.

(b) *Collapse* The patient remains somewhat collapsed throughout his life, face being pale and often leaden and pinched. The temperature is subnormal in the early and important stages but toward the end it may be raised from septic infection.

(c) *Vomiting*—The vomiting due to obstruction especially of the small intestine is persistent and intractable. It is only temporarily relieved by starvation or even by washing out the stomach. The vomit gradually becomes brown and offensive and later faecal.

(d) *Constipation* The constipation is absolute both for feces and flatus. This statement needs a certain amount of qualification. Large enemata may bring away a good deal of feces from the bowel below the obstruction, especially if the obstruction is high up in the small intestine. Again the bowel may act fairly well or there may even be diarrhoea with Richter's variety of strangulated hernia in which the bowel may not be completely obstructed.

(e) *Peristalsis* This when seen is of great importance but it may not be visible with very acute obstruction high up in the small intestine especially if the abdominal wall is thick. Late in obstruction it may cease. Normal peristalsis may be seen through a very thin abdominal wall.

(f) *Quickening Pulse* Although at first the pulse is slow and weak, later it invariably becomes quick and feeble. A quickening pulse is of the gravest significance.

(g) *Thirst* The thirst that usually accompanies intestinal obstruction especially of the small intestine is terrible.

(h) *Insomnia* The subject of intestinal obstruction hardly sleeps at all until the obstruction is relieved unless morphia is given. The administration of morphia for abdominal pain of uncertain origin is to be most strongly condemned for it masks all the symptoms and therefore delays diagnosis and treatment.

(i) *Distension* Gradually the abdomen becomes more distended and supple and moving on respiration.

Of all the symptoms complete constipation is the most important. As a rule the patient has already taken a purgative before calling his

doctor. It is not wise to give repeated purgatives which, failing to act, increase vomiting and collapse, injure the bowel and considerably reduce its chances of recovery after operation. One of the worst purgatives to repeat is calomel, which may become a powerful irritant poison. I have known the repeated administration of calomel, in small doses, lead to ulcerative colitis. Repeated large enemata are much safer, and they give all the information that we require. It must not be forgotten that all the symptoms may be minimised by starvation or masked by the administration of sedatives, especially morphia. There is often a misleading lull due to natural exhaustion. Very soon, however, the symptoms return in an aggravated form and rapidly lead to a fatal result.

When the diagnosis is made, or even strongly suspected, the patient's best chance lies in an operation performed at the earliest possible moment. Nowhere is delay more disastrous.

Diagnosis. We have first to diagnose intestinal obstruction from other diseases which simulate it, and then, if time permits, we may attempt to ascertain the variety and situation of the obstruction.

(1) **Diagnosis of Intestinal Obstruction from other Diseases.** The essential thing in diagnosis is to decide quickly, yet carefully, whether the symptoms are such as to make an early exploration necessary or not. A careful study of the history, signs and symptoms will generally lead to a correct conclusion, but sometimes there are many difficulties. All inflammatory diseases of the abdomen are distinguished by fever, although the temperature may be subnormal soon after the perforation of a viscus or the rupture of an abscess into the peritoneum. Rigidity and tenderness of the abdomen, either local or diffuse, are important indications of local or diffuse peritonitis. Acute hæmorrhagic pancreatitis is often mistaken for intestinal obstruction. The patient, who is often stout and past middle age, is groaning with pain and is of a leaden colour. Pain and tenderness are said to have started, and they often remain worse, in the epigastrium. Sometimes there is a distinct fulness there. Fatty stools result from repeated large enemata, showing that true intestinal obstruction is not present. Moreover, the temperature is often raised and the patient cyanosed. Constipation is rarely complete. Ruptured tubal gestation is characterised by the increasing pallor and blood changes, the more rapid quickening of the pulse rate and the peculiar doughiness of the distending abdomen. The history and examination of the uterus and breasts are often valuable. The best treatment for these conditions is immediate operation, therefore difficulty in deciding between them and intestinal obstruction is no excuse for delaying exploration. Acute gastritis may sometimes give rise to difficulties, but the vomit is not intestinal and constipation is not complete; the general symptoms are not so severe as those of intestinal obstruction. The various colics may give rise to difficulties, but with them, although the temperature is often subnormal, constipation is not complete nor is the vomit brown and offensive. A purgative or an enema may act and flatus is often passed. With biliary colic there may be jaundice or a history of previous attacks. Usually biliary colic is due to the impaction of a stone in the cystic duct; then there are tenderness, rigidity, often a swelling in the right hypochondrium and later a raised temperature. With renal colic the pain is limited to one flank along the course of the

ureter there may be blood corpuscles in the urine with frequency of micturition and cystoscopy after the intramuscular injection of indigo carmine shows no coloured urine issuing from one ureter. The blue line of lead poisoning may suggest the cause of colic. It must not be forgotten however that the presence of a lead line does not exclude more serious disease. I remember two cases in which the discovery of a lead line led to disastrous delay in opening the abdomen. In one case a perforated duodenal ulcer was temporarily overlooked and in the other obstruction by bands. In both of these the delayed operation failed to save life. Lead colic is rarely severe enough to keep the patient awake all night nor is it associated with persistent vomiting. Moreover repeated enemata are effectual.

When face to face with the possibility of intestinal obstruction it is essential to come to a decision without delay. The most important thing to do is to try the effect of large enemata. If two of these fail to do more than bring away a few scybala from the colon intestinal obstruction may be safely diagnosed. Another vital thing is to examine all the vomit. Directly this becomes offensive or brown it is clear that intestinal obstruction is present. Washing out the stomach does not prevent this vomiting for the contents of the obstructed intestine go on regurgitating into the stomach. Sometimes the vomiting ceases when all food is withheld therefore it is often wise to try the effect of food in order to accelerate the diagnosis. It also abates as the colic becomes less frequent and less powerful. Therefore when the stomach is getting distended with brown material the patient is only able to bring up mouthfuls at a time. On passing the stomach tube then one has been astounded to find several pints in the stomach. Another very important thing is to watch the patient carefully when the abdomen is exposed. Within half an hour colic comes on and the patient becomes paler, his face drawn and his abdomen rigid and then peristalsis can be seen and this is usually followed by vomiting. It cannot be too strongly urged that a weak and slow pulse and subnormal temperature are strongly suggestive of intestinal obstruction especially when the other colics can be excluded. When the pulse quickens the patient is rapidly getting worse.

(2) **Diagnosis of the Variety of Intestinal Obstruction** I shall begin with a classification which I find to be useful for want of thought is a more common source of error than want of knowledge. How often do we have to admit that we never thought of that? In many cases if time permits it is possible to arrive at a fairly accurate diagnosis of the nature of the obstruction before the abdomen is opened. This is sometimes of great value for it enables us to consider the various steps of the operation and to anticipate some of the difficulties that we may encounter. In this way the duration of the operation may be diminished and it is certain that in this condition quickness is more important than anything except judicious and careful work. Roughly the causes of obstruction may be divided into —

- (1) Pressure on the bowel from outside
- (2) Disease of the wall of the bowel
- (3) Foreign bodies in the bowel

This rough classification may be amplified as follows —

- (1) *Pressure on the bowel*

(a) External hernia : commonly overlooked, especially when femoral.

(b) Bands and adhesions following appendicitis, tuberculous peritonitis, pelvic peritonitis (especially due to tubal disease), diverticulitis in which the appendices epiploicæ may form bands, Meckel's, gastric or duodenal perforation, and operation.

(c) Internal hernia through a foramen in the omentum, mesentery, broad ligament or diaphragm, into the duodenal or retro-cæcal fossæ or into the foramen of Winslow.

(d) Contraction of the mesentery from tuberculous or malignant disease.

(2) *Disease of the wall of the bowel.*

(a) Intussusception.

(b) Volvulus.

(c) Kink.

(d) Stricture (malignant, tuberculous and traumatic after operation) or strangulated hernia.

(e) Paralysis of the bowel, especially after peritonitis ; or due to thrombosis or embolism of the mesenteric vessels.

(3) *Foreign bodies inside the bowel.*

(a) Gall-stones.

(b) Enteroliths.

(c) Actual foreign bodies, such as hair-balls, mostly in lunatics.

As a general rule obstructions of the small intestine are acute, whereas those of the large are chronic ; but there are important exceptions. For instance, strictures of the small intestine (which are rarely malignant) give rise to chronic terminating in acute obstruction. Again, volvulus of the sigmoid colon gives rise to very acute symptoms, and intussusception, which mostly affects the ileo-cæcal region, nearly always gives rise to acute obstruction. Strangulated hernia is placed first on the list because it is so often overlooked.

Considered generally, without reference to the causation of the obstruction, the successful treatment of acute intestinal obstruction depends largely on two points : (a) **The Question of Operation**, and (b) **The Question of the Extent of Interference that is indicated in any given case.**

(a) **The Question of Operation.** Although cases of so-called "spontaneous cure" have from time to time been recorded, the number of these is so small and the correctness of the diagnosis in many of them so doubtful that, for all practical purposes, it is wiser to leave them entirely out of consideration. For, apart from these and the small number of cases of intussusception that have survived the sloughing of the intussusceptum, as the late Sir F. Treves said, "there is no avoiding the fact that acute intestinal obstruction, if unrelieved, ends in death." This being so, it clearly becomes the duty of the surgeon to operate on every case of acute intestinal obstruction. The operation, moreover, should be performed at the earliest possible moment after the diagnosis has been made, for the operation is in itself not nearly so serious as delay, since the mortality rises extremely rapidly as the period between the onset of the symptoms and the time of operation increases. Neither should uncertainty of diagnosis be allowed to delay the operation, for of the many conditions that simulate acute intestinal obstruction—*e.g.*,

appendicitis, peritonitis from different causes, thrombosis of mesenteric vessels, acute pancreatitis, enteritis, &c—in most an operation may be beneficial while, as to the others, it would be better that an exploratory operation, as long as it is done by skilled hands, took place needlessly than that a remediable condition should be left untouched. Here, again, the valuable opinion of Sir F. Treves may be quoted. "Operation in these cases is too often regarded as a *last* resource. It should be the *first* resource, as it certainly is the *only* resource."

The mortality of all cases of acute intestinal obstruction, as shown by Gibson¹ in a collection of cases operated upon between 1888 and 1898, was about 47 per cent, his list including 646 cases with 312 deaths. During the twenty years ended December, 1907, of 400 consecutive operations at St. Thomas's Hospital² for obstruction from simple causes, excluding external hernia, 56·7 per cent died. Of 143 operations for obstruction due to malignant disease 64·3 per cent died. The mortality during the last five years of the period mentioned was somewhat less, being 45 per cent for simple and 60·7 per cent for malignant cases. The mortality of 1655 operations for acute obstruction (excluding strangulated external hernia) occurring in seven large British hospitals in the five years 1920 to 1924 inclusive was just over 32 per cent, as shown by Mr. H. S. Souttar at the British Medical Association meeting at Bath in July, 1925.³ If the 613 cases of intussusception are excluded, the mortality is over 38 per cent. Although this is without doubt a vast improvement upon former times, it is still to be hoped that in the near future earlier recognition and more immediate operation will do much to bring about further improvement. The results of early, gentle, accurate and speedy operations are surprisingly good, but the average mortality will probably be always high, due chiefly to delay and partly to the complicated nature of the cause of the obstruction, the peculiar vitality of the parts which are damaged and the readiness with which these pass into a condition beyond recovery. The patient is often collapsed from irritation of the abdominal sympathetic, from want of fluid and from the absorption of poisons from the decomposing contents of the intestine. Hence the great importance of recognising that free drainage of the intestine is essential in late cases. Bearing in mind, however, the essentially fatal character of the condition, apart from relief by operation, every successful operation should be looked upon rather as a life saved, than every fatal one as a life lost.

(b) **The Extent of Interference that is indicated in a given Case.** The operation must be according to the state of the patient. These cases of acute intestinal obstruction are not to be grouped together as all equally fit for operation, or as all certain to be relieved by operation as long as this is undertaken early. In some the condition of the patient is good, the abdomen is undistended and a reasonable search for the cause may be made. In others a precisely opposite condition is present, any prolonged exploration is out of the question and all that can be done, if the cause is not found at once, is to open one of the most distended coils, as low down as possible, and drain the intestines (*vide infra*).

¹ *Ann. of Surg.*, 1900, xxxii.

² Sir G. Makins in *Burghard's Operative Surgery*, 1914, ii, 321.

³ *Brit. Med. Journ.*, 1925, ii, 1000.

Preparation for the Operation. While the operating room and instruments are being got ready the patient is carefully prepared in his own room. The bladder is emptied and the abdominal wall cleansed and painted with iodine. An injection of one-hundredth grain of atropine sulphate is given if possible three-quarters of an hour before the operation. When the stomach is distended, as shown by frequent vomiting of small quantities, half a pint of warm water containing 3iv of bicarbonate of soda is given and frequently helps the patient to empty his stomach. In bad cases the stomach should be washed out. In sensitive patients the fauces may be painted with 2 per cent. solution of cocaine. Although the patient has been vomiting frequently in small quantities, the contents of the intestine rapidly regurgitate into the stomach, which may be found to contain several pints of offensive material. The evacuation of this reduces the danger of regurgitation under the anæsthetic and the aspiration of the vomit into the lungs. This has not infrequently led to choking, and in other cases to septic broncho-pneumonia. In most cases saline infusion is also commenced. About two pints of normal saline are introduced into the axillæ by means of the Lane infusion apparatus. Rectal salines by distending the colon may add to the difficulties of the exploration. Every care is taken to keep the patient warm during the operation.

Anæsthetic. The question of anæsthetics in these cases is a very important one, and should be well considered. The impeded respiration due to the abdominal distension is liable to make the administration of a general anæsthetic difficult and dangerous. The tendency to vomit is another grave danger, a sudden attack during the administration having frequently caused immediate death from choking. As already mentioned, this danger can be almost abolished by washing out the stomach beforehand.

Apart from these two considerations, a general anæsthetic seems to have specially depressing effects in cases of acute intestinal obstruction. If long continued it increases shock and post-operative vomiting. For these reasons it is desirable to give as little general anæsthetic as possible. Ether given by the closed method is especially to be avoided, for it does not relax the abdominal muscles sufficiently, it induces cyanosis and is very likely to be followed by pulmonary complications and post-operative vomiting, especially in elderly patients. Warm ether and oxygen given by the open method following atropine is more satisfactory in every way. In some cases gas and oxygen is useful, and in grave cases spinal anæsthesia is valuable as recommended by L. H. McGavin.¹ As he points out, it lessens shock by temporarily paralysing the posterior nerve roots and preventing the depressing influences incident to the peritoneal manipulations from reaching the central nervous system. Moreover, it is rarely followed by vomiting. In some cases the anæsthesia may not be perfect, so that a little general anæsthetic may be required in addition for a few minutes. In grave cases enterostomy may be carried out under regional and local anæsthesia with novocaine.

Operation. I propose to describe the operation generally first, and then to allude to its application to the chief forms of acute intestinal obstruction. The operation to be performed will necessarily vary

¹ *Brit. Med. Journ.*, 1911, ii, 1638.

according to the general condition of the patient, and the mode of procedure will be described under two heads (A) Early cases or where the condition of the patient is good, and (B) Late cases, or where the condition of the patient is bad

A Early Cases. The surgeon makes an incision five inches long over the right rectus muscle near the middle line and beginning just above the level of the umbilicus. The anterior wall of the rectus sheath is incised, and one of its edges is separated from the muscle (Winslow), the muscle fibres are then either separated or drawn outwards, the transversalis fascia and the peritoneum are separated from the deep surface of the rectus, picked up with toothed dissecting forceps and opened with scissors

The peritoneum should always be well lifted up before it is opened, especially if there is distended bowel beneath. The opening is then enlarged with curved blunt pointed scissors, two fingers with the palmar aspect turned upwards serving as the best director

I strongly advise the surgeon to give himself just enough room to get his hand in quickly and explore efficiently without allowing prolapse of distended coils. A short median incision below the umbilicus and the introduction of a couple of fingers is usually futile. If the case has been allowed to go on until the intestines are distended the search for the cause of the mischief will be rendered all the more difficult and there must be sufficient room to introduce the hand freely. If an assistant skilfully keeps the edges of the wound together where this is not occupied by the inserted wrist, the intestines will not escape

The surgeon should now decide which mode of exploration he will make use of. The following is as useful as any. If the parts are not much distended three possible sites of strangulation should be first examined. (1) The cæcum which will give twofold evidence first, its distension or emptiness telling whether the obstruction is above or below it and, secondly, the state of its appendix whether normal or adherent and acting as a band. (2) The pelvis is next examined as bands are often fixed here, and also because in women local peritonitis, originating about the uterus or its appendages and in either sex, about the appendix cæci is often the cause of the obstruction. (3) Next the internal inguinal, the femoral and obturator rings are explored to make sure that no tiny hernia exists, imperceptible from the outside. The fingers are next swept upwards towards (1) the umbilicus, in the hope of finding one of the diverticular bands mentioned at p 343. If an empty coil of small intestine be discovered it should be followed up to the obstruction, which will probably be not far away. This method is easier than following a distended coil

If the search fail—and it often will when distension is present, embarrassing the fingers in their movements and obscuring the relation of parts—one or two of the loops which lie nearest to the wound should be carefully scrutinised. The late Mr Greig Smith said that as the most distended coils just above the obstruction will rise nearest the surface, and as the greater amount of the small intestine is within three inches of the umbilicus, there is a probability that the most dilated coil will be in sight. These should be followed in the direction of increasing congestion and distension, thus leading to the obstruction

Fixity of a coil may be another aid. Where there is ground to believe that the case may be one of acute supervening upon chronic obstruction, the cæcum being full, the pelvic colon should be next investigated. When the transverse colon is distended and the pelvic colon empty, the obstruction will be found near the splenic flexure on passing the hand well upwards and backwards towards the spleen; it must not be forgotten that the colon below the obstruction may be distended from an enema.

If a search for five minutes has failed¹ to find the cause of obstruction, the following courses remain open: (a) Kummell's plan of allowing the small intestines to prolapse under warm and moist aseptic towels to facilitate the search; (b) emptying the most distended coil, and either closing the opening after finding and removing the cause of obstruction, or (c) tying in it a rubber tube making a valvular enterostomy; (d) "short-circuiting."

(a) The objection to this method is, of course, that it is often exceedingly difficult to get the distended coils back into the abdomen, and that the necessary manipulations and exposure must produce shock and may inflict serious damage. If, however, the condition of the patient is satisfactory and the amount of distension not great, it is, if done properly, speedily and with care to prevent undue exposure of, and damage to, the intestines, the quickest and wisest course to pursue. This practice was, moreover, recommended by no less an authority than Sir F. Treves, who considered that the damage done to the intestines by the amount of exposure necessary is probably less than that caused by prolonged manipulations within the abdominal cavity. The abdominal incision should be made very free, and the intestines then allowed to escape between smooth-surfaced sterile towels, wrung out of normal saline solution at a temperature of 110° F. In this way the intestines can be immediately covered with the towels, and the further search for the cause of obstruction conducted with very little exposure or interference. Usually the seat of obstruction will be quickly indicated by the fixity of some loop of intestine, which cannot leave the abdomen. I have found this method very valuable in early cases with only moderate distension; it saves a great deal of time and allows the operation to be completed in a few minutes. To get the intestines back the abdominal wall is held well up and if necessary a moist gauze roll may be used, for this, by clinging to the intestine, facilitates the replacement.

(b) Should, however, the amount of distension be very great, it is wiser to relieve this condition before proceeding further. To this end a different method must be adopted according to the seat of greatest distension. Should this be the *large intestine*, for instance, in a case of volvulus, the distended loop, carefully isolated with packing, may be emptied by puncture with a trocar with a rubber tube attached, such as is often used for tapping the chest or the gall-bladder. Frequently a large quantity of gas escapes, and the intestine collapses. In some cases liquid fæces also are conducted away through the rubber tube

¹ "The difficulty of finding the obstruction in some cases is well shown by Madelung who, in several cases where the seat of obstruction could not be located during life, requested the pathologist, when he made the post-mortems, to locate the obstruction by introducing his hand through an incision, allowing him from ten to twenty minutes for the exploration; in every instance he failed to find the obstruction within the specified times." —Senn, *loc. supra cit.*

without contaminating the wound. As the trocar is withdrawn a purse string suture, previously inserted is tied avoiding all leakage. To relieve the gaseous distension of a volvulus when the trocar is not available the isolated loop may be punctured with an ordinary cutting needle or the point of the scalpel. If the cause of obstruction cannot be found or if it proves to be a growth of the colon a cæcostomy or a temporary or permanent colostomy should be performed *see* Chapter XIV or a short circuit made in suitable cases *see* Chapter XVII. In some cases of irremovable growth when the patient has a great abhorrence

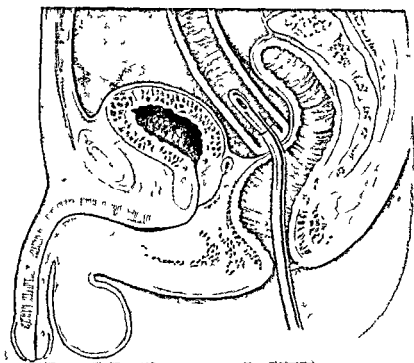


FIG 208 Ileo rectostomy. A rubber tube is fixed laterally in the sigmoid about 10 inches from the ileo cæcal valve. The tube is drawn through an incision on the outer or wall of the rectum below a growth in the pelvic colon. It is drawn well down and sewn to the anus so as to maintain serous apposition between the sigmoid and rectum.

of colostomy, ileo rectostomy or colo rectostomy may be performed with the aid of a tube as shown in Fig 208. The tube is inserted laterally in an air tight manner with a few sero muscular invaginating sutures added.

If, on the other hand it is found that the *small intestine* is the seat of most distension then very little advantage will be gained by either temporary puncture or incision for the acute flexures caused by the distension will prevent more than a very small portion of the gut being emptied at once. A short-circuit between the bowel well above and a little below the obstruction is better but if the condition of the patient is very grave it is wiser to use an enterostomy tube for a few days. In many cases it is necessary to do this although the cause of the obstruction

has been removed, for the distended bowel will not recover its power without free drainage.

(c) Where the patient's condition makes any further search dangerous, or where there is great distension, a temporary enterostomy must be made.

(d) Short-circuiting. It is evident that it is only to a few cases that this method is suitable—*e.g.*, cases of matting together of coils of small intestine, as after previous mischief set up by a mesenteric gland or appendicitis. In such cases if there is inextricable matting, but no recent inflammatory changes and nothing like gangrene, a coil of the distended small intestine may be short-circuited to the most conveniently placed piece of healthy intestine beyond the obstruction. A drainage-tube is inserted at the lower angle of the parietal wound if the peritoneum has been contaminated. In early and favourable cases the wound may be sewn up in three layers in the usual way. In grave cases only stout salmon-gut sutures piercing all the layers are used; and these are introduced rapidly with very large curved needles, while the parietes are held up away from the intestines.

B. Late Cases. Here the condition of the patient will not allow of any but the briefest operation. After the injection of novocain for regional and local anæsthesia a small incision, two inches long, is made near the median line below the umbilicus. On opening the peritoneum the most distended coil projects into the wound. If not, two fingers are introduced and carefully feel for the most distended coil within reach and bring this up into the incision for a temporary enterostomy to be performed at once (p. 268).

It may happen that this plan will result in the opening of a coil some distance above the obstruction or that the obstructed portion of intestine is already gangrenous. In the former case relief is usually afforded, but in the latter the gangrenous loop perforates and almost inevitably leads to fatal peritonitis. On the other hand, it may be argued that in these extreme cases further interference would be almost certainly fatal, even if the cause of obstruction were removed, and, moreover, that the most distended coils of intestine usually rise to the surface and are situated close to the umbilicus; and, finally, that many lives have certainly been saved by enterostomy.

Having spoken of the operation generally, I shall next refer to a few practical points connected with the chief causes of obstruction individually.

I. Strangulation by Bands and through Apertures.¹ A. Bands. A band may either (a) run across the bowel and obstruct it without fear of causing more than strictly local gangrene, or (b) it may strangulate a loop of bowel which has slipped under it, a far more serious affair quickly leading to death of the loop unless prompt relief is given. (1) Adventitious Peritoneal Bands. Perhaps there has been a history of peritonitis, starting possibly from the appendix, the uterus and appendages or a mesenteric gland. (2) Omental Bands. Here some part of the lower end of the omentum has become adherent to the brim of the pelvis, a hernial orifice, a uterine appendage, the cæcum or a tuberculous mesenteric gland. (3) Meckel's Diverticulum.² This is usually met with in young

¹ Sir F. Treves (*Intest. Obstruct.*, p. 13; *Dict. of Surg.*, ii, 802) groups these together from the similarity of their obstruction and their close resemblance to strangulated hernia.

² For an account of other surgical conditions due to Meckel's Diverticulum, *vide* p. 409.

subjects Tubular or cord like it will be found attached at one end to the ileum, at the other near the umbilicus or to the mesentery or intestine Under this arch small intestine is very liable to slip In other cases one end is free and ensnares or knots up a loop of intestine (4) Some normal structure abnormally attached e.g. the Fallopiian tube or the appendix

In most cases bands, when found are not difficult to deal with If they do not give way to the finger as attempts are made to hook them up, they should be excised between two ligatures Occasionally transfixion is required When one band has been discovered the possibility of a second, attached to the pelvic brim must always be remembered In Gibson's list of cases there are 186 of obstruction by bands and in no less than thirty three of these there was a record of more than one band being present it is probable that the proportion is even higher than this

On the division of the band the piece of intestine which has been released may be found to be gangrenous or even perforated allowing its contents to escape into the peritoneal sac sooner or later unless steps are immediately taken to prevent this catastrophe

Every band should be resected as closely to its attached points as is safe, and its stump buried if possible to prevent any recurrence of the trouble

CASE I Acute Intestinal Obstruction by a Band Appendix adherent to Caseo is Mesenteric Gland Boy aged 6 years The patient was seized with very violent pains in the abdomen on the morning of April 10 1911 His father gave him two large doses of castor oil which failed to have the desired effect He was admitted into Cuy's Hospital, he had a subnormal temperature and was blue cold and pulseless His abdomen was considerably distended but flaccid It was full in the flanks and there was a palpable swelling in the right iliac region On admission at 8 A.M. on the 11th he was too bad for operation and was therefore infused into the axilla

Operation The abdomen was opened at 9.30 A.M. the patient having been given ether The lower part of the right rectus was displaced inwards The peritoneum seemed to be purplish and clearly contained blood It was opened and a large amount of sanguinous fluid escaped clearly showing that the condition was one of intestinal obstruction and not appendicitis Dark purplish but not gangrenous coils of small intestine were at once seen Several coils were withdrawn and a band was seen consisting of the appendix adherent to a caseous mesenteric gland This was astride the lower end of the ileum close to the caecum and completely obstructed it The adhesion to the tip of the appendix was divided and the empty caecum drawn away from its former position which was unusually high The abdomen was then closed with through and through salmon gut sutures The operation lasted seven minutes (the patient was only in the theatre ten minutes) He was not much worse at the end of the operation but the infusion which was carried on throughout the operation was continued Pituitary extract was injected in 5 m. doses The patient rapidly recovered

Meckel's Diverticulum This may act as a band over the intestine, and frequently this foetal relic becomes twisted at its base, obstructing the parental bowel The diverticulum is usually within three feet of the ileo caecal valve There is often a history of previous attacks of colic, and a diagnosis of appendicitis has often been suggested In the case of a diverticular band which is tubular, the neighbouring intestines and the abdominal wall are protected with gauze packs and the diverticulum is divided between two clamps near its base The stump is cleaned with methylated spirit and closed with two continuous invaginating sutures When the diverticulum is narrow the simplest and most rapid way is to

crush, tie and bury the stump by means of one or two purse-string sutures passing through the sero-muscular coats round the base.

In some cases gangrene of the ileum occurs at the twisted base of the diverticulum, and then a resection, with or without intestinal drainage, will have to be undertaken, unless the area of gangrene is so small that inversion can be performed without risk of narrowing the lumen too much.

A most interesting and fully reported case successfully treated by laparotomy was published in the *Lancet*, March 9, 1889, by the late R. J. Pye-Smith, of Sheffield. Others successfully treated in the same way by Clutton,¹ McGill,² and Roberts³ will well repay reference. The following case was operated on by Mr. B. L. Laver:

H. C., æt. 25, was admitted to Guy's Hospital under Mr. Rowlands at 6 P.M. on June 30, 1925, suffering from abdominal pain and vomiting.

He had always been liable to "bilious attacks" but had had no other illnesses.

On June 28 he was seized with abdominal pains immediately after his dinner at midday. The pain was severe and located to the umbilical region. He then vomited the meal he had just taken and had his bowels opened once. The pain continued until his admission, and the vomiting became more and more frequent. His bowels were not opened again.

Examination in the ward after admission showed a thin man lying on his back and, obviously, suffering considerably. The abdomen was distended but moved fairly well on respiration; there was no visible peristalsis. There was no hyperæsthesia or rigidity, but a slight sense of increased resistance could be made out in the right iliac fossa. The hernial orifices were clear; there were no scars on the abdomen. The tongue was furred but not dry. Pulse 70, temperature 98, respirations 24.

A diagnosis of acute intestinal obstruction was all that could be made and immediate operation decided upon.

Under general anaesthesia the abdomen was opened through a right paramedian incision, the rectus being drawn outwards. Dilated small intestine at once presented itself, and on passing the hand down towards the cæcum a cystic tumour about the size of a foetal head was encountered. This was carefully withdrawn and was found to be a large diverticulum which had caused obstruction by kinking the small intestine just distal to it. Towards the free end of the diverticulum the wall had given way to a certain extent and a patch of plastic peritonitis marked the site.

The diverticulum, together with several inches of small intestine on each side of it, was resected and an end-to-end anastomosis performed. This was found to be quite simple, in spite of the difference in the lumen of the gut above and below the site of obstruction. As the small intestine was dilated to about three times its normal diameter throughout its whole extent, it was considered necessary to do something to release the tension above; accordingly, a high jejunostomy about four feet from the duodeno-jejunal flexure was performed, after Witzel's method of gastrostomy. The tube was passed through the great omentum before being brought out of the abdomen through a stab wound in the left rectus. The abdomen was then closed. At the end of the operation the pulse was 114.

His general condition for the first two days was only fair, and his pulse showed a tendency to climb. He drained 10 ounces of fluid through his jejunostomy tube in the first twenty-four hours, 3 ounces during the second, 104 during the third, and 8 on the fourth. On the third day, coincident with the profuse drainage from the tube, his condition improved, and on the fourth day the tube, which had been fixed in the gut with the finest catgut, came out. It was not replaced and his bowels were opened with an enema. On the fifth day his bowels opened naturally, and thenceforth he made a rapid recovery. He left hospital twenty-one days after admission in excellent condition.

This is a very fatal form of obstruction, chiefly because of mistakes in diagnosis and delay in operating.

¹ *Clin. Soc. Trans.*, 1884, xvii, 186.

² *Brit. Med. Journ.*, January 14, 1888.

³ *Ann. of Surg.*, 1906, xliv, 87.

Gibson found the mortality to be 55 per cent in forty two operations for intestinal obstruction due to this structure

B Apertures and Slits. These may be congenital or traumatic, the intestine entering and enlarging a congenital retro peritoneal fossa or slipping through a rent in the mesentery, omentum broad ligament or diaphragm

(a) **Retro-peritoneal Hernia.** For most of the information upon this subject I am indebted to the valuable and exhaustive work of Moynihan and Dobson¹

The chief varieties are

- (1) The left duodenal, of which over sixty cases have been recorded
- (2) The right duodenal of which over seventeen cases have been recorded
- (3) The mesocolic of which only one certain case has been recorded (Dobson), and possibly that described by Sir Astley Cooper years ago
- (4) The infra duodenal of which Molin has described the solitary recorded instance

All these arise in the neighbourhood of the termination of the duodenum, the left duodenal hernia occurring into the para duodenal fossa of Landzert, which has the inferior mesenteric vein in its prominent left, lower and upper borders. The right duodenal which occurs into the mesenterico parietal fossa of Waldeyer, which lies in the root of the mesentery of the upper part of the jejunum and has the superior mesenteric artery in its prominent anterior border. The mesocolic hernia is to the left of the inferior mesenteric vein the infra duodenal lies below the duodenum and has no vessels in the prominent edge of its orifice

The left duodenal hernia enlarges upwards and to the left towards the spleen, its orifice being placed antero internally in small herniæ and postero-internally in larger ones

The right duodenal enlarges downwards and to the right towards the right iliac fossa, its orifice being directed upwards and to the left. Duodenal herniæ nearly always contain only small intestine but Freeman² has recorded a case in which the entire small intestine the cæcum and a part of the colon had passed into a left duodenal hernia

(5) *The pericæcal* which may be subdivided into the ileo appendicular, of which seven cases are recorded the retro colic, of which eight cases are recorded, the hernia into the fossa of Hartmann which is a fossa placed between the mesentery of the appendix and a continuation of the mesentery of the small intestines to the iliac fossa, one possible case is recorded

Hernia into the sub fascial or iliac fossa, which is a pouch of peritoneum pushed downwards through a weak spot in the iliac fascia and outside the psoas muscle, two cases of this are recorded, and Mr Dunn operated upon another one at Guy's Hospital some years ago

(6) *The intersigmoid* Only two genuine cases are recorded, those of Eve and MacAdam Eccles

(7) *Hernia into the lesser sac of the peritoneum*, twelve instances of which are recorded

¹ *Retro-Peritoneal Hernia*, Moynihan and Dobson, 1906

² *Amer Journ. Med Sci.*, October 1903

Diagnosis will generally be arrived at only during a laparotomy for the relief of intestinal obstruction, but in some cases, such as that of Sherren, a diagnosis has been made before the operation.

In addition to the classical symptoms and signs of acute intestinal obstruction, other points may suggest or even strongly indicate a retro-peritoneal hernia.

The existence of a duodenal hernia may be indicated by the presence of a "palpable definite resonant mass" at the upper and left part of the abdomen (left duodenal hernia) or at the lower and right part (right duodenal hernia). This mass does not move on respiration, and coils of intestine may be evident towards the middle of the swelling, the size of which may vary with the severity of the symptoms.

Hæmorrhoids or rectal hæmorrhage may develop in left duodenal hernia from obstruction of the inferior mesenteric vein.

Only one case of pericæcal hernia has been diagnosed before operation, from the presence of a mass in the right iliac fossa which was rendered more evident by means of rectal injection (Riese).

Hernia through the foramen of Winslow may be indicated by agonising pain in the epigastrium, where a semi-resonant tumour may soon appear.

Treatment. When the nature of the obstruction has been recognised, attempts should be made to reduce the hernia by a combination of pressure upon the sac and gentle traction upon the intestine. In some cases it may be possible to enlarge the orifice by stretching, in others the prominent margin may be divided, due care being taken to avoid any prominent blood-vessels. In left and right duodenal hernia it may not be possible to enlarge the opening without injuring the inferior mesenteric vein in the one case or the superior mesenteric vessels in the other. Haberer in his successful case divided the inferior mesenteric vein, which he then found to be already thrombosed.

The foramen of Winslow is not capable of enlargement, surrounded as it is by the liver above, the vena cava behind, the twist of the hepatic artery below and the portal vein, bile duct and hepatic artery in front. The difficulties that may be met with are illustrated by Sir Frederick Treves's case.¹

Here the surgeon not only failed to reduce the gut by operation during life, but at the necropsy he could not bring about reduction until the hepatic artery, portal vein and bile duct were severed.

Incision of the anterior layer of the gastro-hepatic omentum and retraction of the first part of the duodenum with the view of enlarging the opening is considered by Moynihan to be impracticable in cases of obstruction, and I do not believe that it would be any good, for the twist of the hepatic artery would still form the lower boundary of the ring.

Mobilisation of the duodenum by incising the posterior parietal peritoneum to the right of it and detaching it forwards and downwards enlarges the orifice according to Moynihan, but he considers this measure to be almost out of the question in a patient suffering from acute intestinal obstruction.

When the rings cannot be enlarged by stretching and vessels prevent an incision being made, it is best to open the sac anteriorly and to try to

¹ *Oper. Surg.*, i, 389.

reduce the bowel from within. This may only be practicable after pulling out a loop of distended bowel and emptying it through an incision made along its convex border with all precautions against contamination of the peritoneum. The incision having been closed the reduction will probably be easily performed.

An attempt should be made to close the neck of the sac to prevent a recurrence of the hernia and the necessity of this is shown by the recurrence in Mr Paton's case.

It may be neither wise nor necessary to prolong the operation by attempting to close the foramen of Winslow for a recurrence is not likely here.

Results. Owing to delay in diagnosis before and during operation severe damage to the bowel and the difficulties of reduction strangulation in a retro peritoneal hernia is a very grave affection carrying a high mortality. Some successful cases have however been recorded.

Several successful operations for hernia at the foramen of Winslow have been recorded but in one of these spontaneous reduction occurred after the surgeon had failed to reduce the hernia during the operation.

(b) **Traumatic apertures** may be formed in the diaphragm omentum mesentery or mesocolon and may result from crushing violence gun shot and other wounds or careless operations during which certain openings may not be properly closed. For instance after gastro jejunostomy a hernia may occur through the rent in the mesocolon and the same thing may follow resection of intestine unless the mesentery is properly sutured.

The following is an instance of a hernia through a hole in the mesentery.

In Mr Howard Marsh's case¹ a loop probably in the middle of the jejunum had slipped through a hole in the mesentery. The edge of this opening was so yielding that Mr Marsh could readily stretch it with his finger nail sufficiently to allow the loop to be drawn out. The patient made a good recovery though in much danger for a while from the paralysed condition of the intestine.

Diaphragmatic Hernia. Although over a thousand cases of diaphragmatic hernia have been recorded the condition remains a pathological curiosity for the large majority of cases have been infants born dead or dying soon after birth. Comparatively few have been recognised during life. Fewer still have been treated surgically and most of the operations have been unsuccessful. Marshall Lloyd found only two cases recorded in the surgical reports of Guy's Hospital between 1866 and 1920. Both were due to crushing and the patients died shortly after admission without an operation. No surgeon has had personal experience of more than a few cases. It is therefore important that every case should be published so that its clinical recognition and treatment should be put on a firmer basis.

Etiology. Diaphragmatic hernia may be congenital or acquired but the majority are congenital. Out of 433 cases analysed by Grosser and Thoma 232 were congenital and 181 acquired but it is very often difficult to settle this point. Hume² has carefully described the various types of this condition.

¹ *Brit Med Journ.* June 2 1888.

² This account is an abstract of a paper by one of us (R. P. R.) in the *Guy's Hospital Reports* 1921 lxx 91.

³ *Brit Journ Surg* 1922 x 207.

Few subjects of congenital hernia survive and in those that do the symptoms may come on insidiously for years and culminate in an acute attack of strangulation or obstruction of the stomach or intestine. The acquired or traumatic variety follows a wound or laceration of the diaphragm due to direct or indirect violence, such as violent crushes or gunshot wounds: the latter have accounted for many recent cases during the War. Battle and Mackenzie¹ record an interesting case of strangulated diaphragmatic hernia occurring three years after a poinard wound in the left side and, in an exhaustive paper, G. W. Bryan² deals with other injuries of the diaphragm.

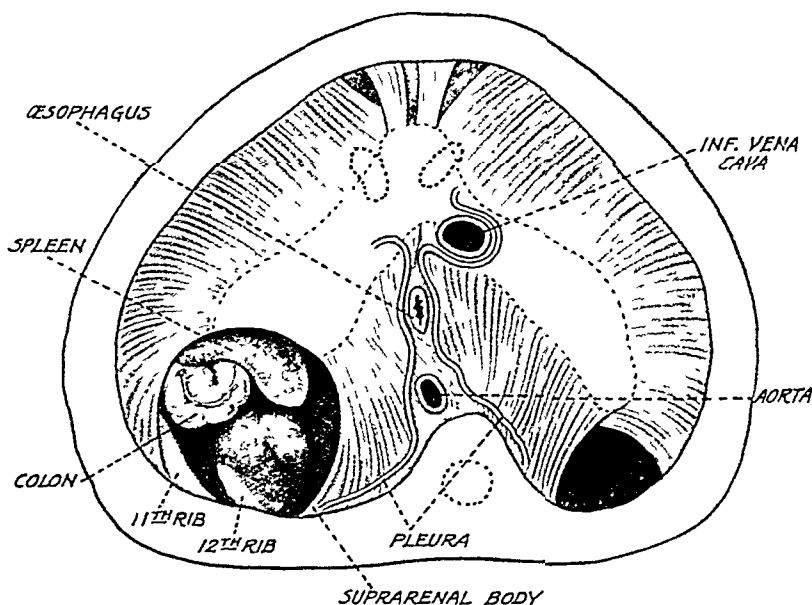


FIG. 209. Diagram illustrating development of the diaphragm (Keith)

The hernia may be true or false. If true, it possesses a sac formed of peritoneum or diaphragmatic pleura or both, but in most instances it is false and has no sac, the stomach being in contact with the lung. Most of the clinical cases have been recognised at operations undertaken for some emergency, such as intestinal or pyloric obstruction. In many cases even laparotomy has failed to discover the hernia or, having discovered it, the surgeon has sometimes been unable to reduce its contents or close the gap in the diaphragm.

As pointed out by Keith,³ the diaphragm is developed from five segments (Fig. 209), a mesial and two lateral on each side which join together. Large or small gaps may be left between any of these segments, especially between the lumbar and the costal parts behind (foramen of Bockdoleki) and, more rarely, between the sternal and costal parts in front (foramen of Morgagni). In most congenital cases there is a direct opening from the peritoneum into the pleura on the left side. In a

¹ *Lancet*, 1904, ii, 1582.

² *Brit. Journ. Surg.*, 1921, ix, 117.

³ *Brit. Med. Journ.*, 1912, ii, 1297.

personal letter Sir Arthur Keith kindly writes "It is just possible that there may occur in the human diaphragm two other congenital openings besides the two usual (pleuro peritoneal) ones. These ventral pericardio peritoneal passages do not form in the human embryo but as they are normal in certain fishes they ought to occur in us occasionally. They should always open into the pericardium. I think all other openings are the result of injury. Apart from such definite apertures these gaps in the muscle are weak spots which may give way when the abdomen is crushed. In some cases the hernia is through the œsophageal opening."

The condition is eight times more common on the left than on the right side owing to the protection of the liver. Usually a small projection of the liver only is found in a right sided hernia but the stomach has been found in the right pleura and in at least one instance the hernia has passed into the pericardium.

The contents of a diaphragmatic hernia vary greatly. The stomach great omentum and splenic flexure of the colon are the most common but the spleen small intestine tail of the pancreas and even the greater part of the large intestine may be in the hernia. Adhesions are apt to form in the hernia and dilatation ulceration or even perforation of the stomach or intestine may be caused by obstruction at the hernial orifice.

Signs and Symptoms. These vary greatly depending chiefly on the contents of the hernia and the presence or absence of obstruction of the stomach or small or large intestine. In acute cases dyspnoea severe thoracic pain and cardiac distress may be evident from interference with the left lung and displacement of the heart. When the stomach or pylorus is obstructed or strangulated vomiting which is sometimes frequent and severe hæmatemesis severe epigastric pain and a carinated abdomen are noticed. Sometimes there is dysphagia from obstruction of the cardia. Wilks¹ drew attention to excessive thirst as a suggestive symptom of strangulation of the stomach. When the obstruction concerns the intestine and especially the colon some of these symptoms may be replaced by those of intestinal obstruction and the abdomen may be markedly distended. The possibility of a diaphragmatic hernia should therefore be remembered especially when the cause of obstruction cannot be made out during an exploration.

In chronic cases the symptoms often come on insidiously and are less clear. Tympanites extending high into the chest gurgling splashing metallic tinkling and distant breath and voice sounds over the lower part of the left side have been noted. The upper part of the chest is usually normal or hyper resonant.

Diagnosis. The history and signs of a wound or an injury are of great assistance in acquired cases. Often diaphragmatic hernia has been mistaken for intestinal obstruction due to other causes or for gastric ulcer with or without pyloric stenosis the symptoms being due to compression of the stomach or pylorus or even to secondary ulceration. In several cases it has been mistaken for gall stones. Eventration or chronic idiopathic elevation of the left side of the diaphragm—of which only twenty cases have been recorded—pneumothorax hydropneumothorax hæmo pneumothorax and pyo pneumothorax have caused real difficulties in diagnosis and a diaphragmatic hernia has been tapped or incised in

¹ *Lancet* 1858 i 434

error. In diaphragmatic hernia the breath and voice sounds are scarcely diminished whereas they are absent in pneumothorax, and metallic tinkling is associated with peristalsis and not with respiration. Moreover, gastric disturbances are not marked with pneumothorax. Cæsophageal pouch and stricture of the cæsophagus have also been confused with diaphragmatic hernia. Out of 650 cases discussed by Giffin,¹ only fifteen were correctly diagnosed during life.

The X-ray appearances are by far the most important aids in the diagnosis. An opaque meal may definitely show the stomach to be above the diaphragm. Above the barium in the stomach the usual gas bubble is easily recognised, bounded by a definite curved line indicating the wall of the stomach. This must not be mistaken for the usual bow line of the diaphragm, which is much lower and less acutely curved. In these cases the outline of the diaphragm is rather indefinite and irregular on the left side, and it does not move well on respiration; the left cupola may move up while the right moves down during inspiration. On careful observation lung tissue may be seen through the air bubble above the opaque meal. This is most valuable in distinguishing diaphragmatic hernia from eventration and all the varieties of pneumothorax. The administration of a Seidlitz powder by the mouth may help this examination by distending the stomach with gas. An opaque cæsophageal tube may be seen to pass up again through the diaphragm into the part of the stomach in the hernia. After an opaque enema has been given the splenic flexure of the colon may be shown above the diaphragm, and in some cases it has been seen to reach as high as the clavicle. This is conclusive evidence of diaphragmatic hernia.

Operation. Without an operation the outlook is usually very bad, but a few patients have survived for many years and have ultimately died from other causes, the condition being perhaps first discovered after death.

When performing an operation there are three routes to choose from: (1) abdominal, (2) thoracic and (3) a combination of the two.

(1) Very few operations have been deliberately undertaken with the diagnosis already made; out of fifty-three operations done, in only six was a correct diagnosis made beforehand. In most cases the abdomen has been opened for intestinal or gastric obstruction and the hernia discovered in this way. The abdominal route has therefore been used more frequently than the thoracic, but it certainly does not seem to be always the best route for, even when the abdomen has been opened, the true condition has often remained undiscovered. In many cases it has been impossible to bring the contents of the hernia back into the abdomen, owing to adhesions in the sac and powerful thoracic suction. This force is so strong that, even when the hernia has been reduced, it has sometimes been found impossible to prevent the immediate return of the viscera into the chest. Closing the aperture in the diaphragm from below has also been very difficult or impossible. In several cases such makeshifts as sewing the stomach to the edges of the aperture,² to the abdominal wall,³ or to the right flank have had to be adopted even by very skilful

¹ *Ann. of Surg.*, 1912, v, 388.

² W. A. Sherwood, *Ann. of Surg.*, 1925, lxxxi, 1026.

³ F. S. Mathews and H. M. Imboden, *Ann. of Surg.*, 1920, lxxii, 668.

surgeons. Gastro-pylorostomy has had to be performed after failing to bring the greater part of the stomach and pylorus back into the abdomen. The abdominal route has, however, the advantage of allowing a complete exploration of the abdomen in acute and traumatic cases, but in chronic cases this exploration is rarely required. The best abdominal access to the left side of the diaphragm is given by a long, oblique incision, one inch below and parallel to the left costal arch.

(2) The thoracic route provides by far the most direct access and the best view of the contents of the hernia and of the aperture in the diaphragm. It makes the separation of adhesions easier and far safer, it abolishes the thoracic suction, which is so powerful a hindrance to reduction from the abdomen if the chest is not opened also, and it makes the suture of the aperture a comparatively easy operation. A long incision should be made through the eighth left intercostal space or the greater part of the eighth rib should be excised and good retractors used—such as those of Tuffier. Several surgeons have raised a flap, including about five inches of the seventh or eighth ribs, but the simpler incision is probably the better.

The thoracic route is clearly the best for chronic cases. Cranwell,¹ Carson,² Barton,³ Truesdale⁴ and others have successfully adopted it. In fifty two recent traumatic cases without strangulation analysed by Binnie⁵ the mortality for the thoracic route was only 9.6 per cent compared with 50 per cent for the abdominal route. In cases with strangulation the mortality was 50 per cent for the thoracic route and 100 per cent for the abdominal (Neugebauer⁶). Scudder⁷ analysed fifty three operations—eleven thoracic with seven recoveries and forty two abdominal with seven recoveries. It is probable, however, that the abdominal route was adopted in the most severe cases on account of signs of associated injuries in the abdomen.

(3) Neugebauer, Morriston Davies⁸ and others have extended an abdominal wound near the left linea semilunaris up through the costal arch to the chest. This appears unnecessarily severe. Others have made separate abdominal and thoracic incisions after failing to reduce the hernia through one only. This appears to be the best plan in difficult cases.

Whichever route is adopted it is most important to maintain asepsis, to stop all bleeding and to close the chest completely in order to prevent secondary infection of the large cavity left in the chest. Great care and patience are required to close the hernia aperture completely. Numerous Lambert sutures passed from above the diaphragm are very effective. When the gap is very large a fascial graft may be used.

Elevation of the chest naturally helps the reduction of the hernia and insufflation or intra tracheal anaesthesia, although not indispensable, is of undoubted value during the operation, for it greatly diminishes the respiratory movements of the chest and abdomen.

¹ *Proc. de Chir.*, 1908, xxxvii, 33

² *Interstate Med. Journ.*, 1912, xix, 315

³ *Brit. Med. Journ.*, 1919, i, 767

⁴ *Ann. of Surg.*, 1921, lxxiv, 347

⁵ *Operative Surgery*, 1916, p. 620

⁶ *Arch. f. Klin. Chir.*, 1904, lxxvii, 1014

⁷ *Surg. Gynec. and Obst.*, 1912, xv, 261

⁸ *Surgery of the Lung and Pleura*, 1918

The air or secondary aseptic effusion replacing the hernia in the thoracic cavity is gradually absorbed or, failing this, it may be aspirated. The lung as a rule expands very slowly, for it may be atelectatic, bounded by an adherent sac or congenitally small. In one case it was entirely absent.

The following is an account of a case shown by the writer at the Royal Society of Medicine (Clinical Section) in November, 1920. It is one of the few congenital cases which have been diagnosed and which have recovered after operation.

T. M., aged 19, about eight months ago first began to get pains in the epigastric region about an hour after meals, sometimes accompanied by vomiting. The pain was considerably relieved when in the left recumbent position. Since the onset of symptoms the period between meals and the onset of pain has become lessened, and now he experiences pain directly after meals. There is much flatulence. If he finds the pain is not allayed after meals he induces vomiting. There has been no hæmatemesis and the bowels are regular. There has been no respiratory distress. About six months ago the patient was operated on elsewhere for supposed gastric ulcer. The stomach was found fixed high up in the epigastrium. The condition was not diagnosed, and the abdomen was closed without further interference. Three weeks after the operation the pains became the same as before. On admission to Guy's Hospital the patient was thin and anæmic. Definite sinking in of the epigastrium was observed and the abdomen moved well. There was no tenderness and no abnormality on palpation. The lower ribs were unduly prominent on the left side in front, this being limited above by a sulcus running transversely at the level of the episternal notch, like a unilateral Harrison's sulcus. The patient had noticed this for six months. The chest otherwise looked normal. The heart appeared to be normal. On percussion, normal resonance was found over both sides, except below the scapula on the left side, where the note was tympanitic and at the left base where the note was impaired. Air entered all over both sides, but the air entry and voice sounds were weak at the left base. No borborygmi or metallic tinklings were heard in the chest. Mr. M. Coburn suspected diaphragmatic hernia and sent the boy to be radiographed.

The X-ray examination on October 1, 1920, by Mr. J. M. Redding, showed that the œsophagus passed down to the level of the lower border of the eleventh dorsal vertebra, and then turned to the left to join the stomach. The whole of the stomach lay above the diaphragm, the fundus behind and the pylorus antero-internally. The œsophagus entered the fundus at its lowest part. The motility of the stomach was good and the meal left normally, but the duodenum did not appear to follow its normal course; none of the small gut appeared to be above the diaphragm. Some of an opaque meal given on a previous day was now seen in the splenic flexure above the diaphragm. The stomach was empty in five hours.

The operation was performed under intra-tracheal ether, the patient lying on his right side. An eight-inch incision was made over the eighth left rib, which was removed subperiosteally, and the chest opened, displaying a large serous cavity occupying the lower two-thirds of the left chest. Through the upper thin wall of this cavity the base of the lung could be seen, but it was not in the cavity which contained nearly the whole of the stomach, the splenic flexure of the colon and the spleen. There were some adhesions between the stomach, the great omentum and the wall of the cavity, and especially binding the spleen and colon to the back and left side of the cavity and the edge of the opening in the diaphragm (Fig. 210). The surface of the stomach was inflamed and bruised near the pylorus from friction against the front and inner edge of the opening. The latter was four inches long and one inch wide and placed near the back of the diaphragm, extending downwards and outwards to the chest wall from near the œsophageal opening of the diaphragm. Its edges were thick and smooth. The anterior edge was much more definite than the posterior. The opening was clearly congenital, and consisted of a slit between the lumbar and costal muscular fibres. After separating the adhesions and tying many of them, the viscera were returned to the abdomen and the opening of the diaphragm closed with many catgut sutures. The parietal opening was then completely closed.

The patient was somewhat shocked after the operation, but revived after saline enemata, and the pulse never went above 120. The wound healed well. The patient got up and walked fourteen days later. He has improved generally in health since and has put on weight. His symptoms have been completely relieved.

An X ray report on October 22 stated that "there is a large opacity at the base of the left lung which is probably caused by pleural thickening or blood in the old hernial sac. The opaque meal passes freely through the oesophagus into the stomach which is lying in normal position in the abdomen and shows no abnormality." A further radiogram taken on November 11 showed marked diminution of the opacity in the left chest, proving that the lung was expanding quickly. He was well in 1926.

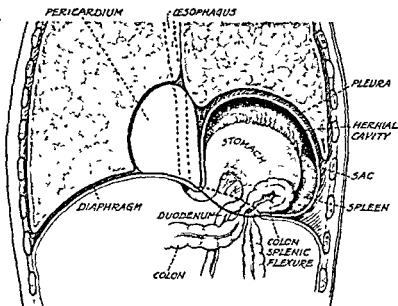


FIG 210 Diaphragmatic hernia. The whole of the stomach, spleen and part of the splenic flexure of the colon are in the hernia.

II Intussusception. From its frequency, especially in early life, its fatality in infants and the fact that its treatment by early and speedy operation is very satisfactory (partly because its diagnosis is easier than that of other forms of obstruction) this deserves careful notice.

Diagnosis. Nowhere is early diagnosis more imperative. This should be based upon the following symptoms:

Sudden abdominal pain followed by shock and spasmodic attacks of colic, as indicated by frequent fits of crying and pallor, more or less frequent evacuations of blood and slime with no faecal matter, except quite early in the case, vomiting, and perhaps a sausage shaped tumour discovered by abdominal or bimanual palpation. The absence of a palpable tumour is far from conclusive negative evidence, even when the abdominal wall is relaxed under the influence of chloroform, and failure to find one must not be allowed to delay an exploration indicated by more important signs and symptoms. Erdman¹ found that no tumour was palpable in 60 per cent of his cases, either by the rectum or through the abdominal wall. I think that this experience is unusual, however. Sir Cuthbert Wallace found a tumour in all of his twenty cases. A dependent lobe of

¹ New York Med. Journ., May 14, 1904.

the liver, a large low kidney, a mass of mesenteric glands, a fæcolith and a prolapsed spleen have each been mistaken for an intussusception.

Three more points must always be remembered in the diagnosis of intussusception: (1) that in cases which are not acute there may be very few symptoms for a time; for instance, in subacute cases some fæces may pass, and a diagnosis of colitis may be made; (2) the rectum must always be examined, and any intussusception which may be met with not mistaken for a prolapsus; (3) radiographic examination after an opaque meal has demonstrated intussusception, and is of special value in subacute and difficult cases. In acute cases it is rarely wise or necessary to waste any time on this examination.

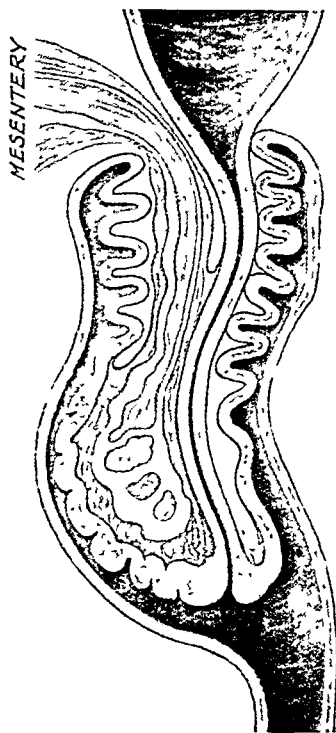


FIG. 211. Diagram of an intussusception in vertical section.

The disease should be diagnosed long before the stage of distension and collapse. Careful consideration of all the points mentioned above will usually prevent delay and enable the surgeon to avoid a mistaken diagnosis of enteritis. In cases of grave doubt the abdomen must be explored.

Perrin and Lindsay in their useful analysis of 335 classified cases at the London Hospital found that 46·5 per cent. were ileo-caecal, 37·6 per cent. ileo-colic, 10 per cent. ileic and 5·6 per cent. colic.

Treatment. If a capable surgeon is available, laparotomy should be performed without delay when the diagnosis has been made, for an early operation quickly performed is the only reliable and hopeful treatment. In very early cases reduction may be possible with comparatively little force and may be brought about by injection or inflation, but the results

of this treatment are so unsatisfactory and deceptive that no reliance must be placed on it when suitable surgical aid can be obtained without delay. Very soon the engorgement of the intussusceptum and included mesentery or the adhesion of the entering and returning layers as the result of peritonitis renders reduction much more difficult or impossible. In such cases distension of the colon will either fail altogether or will produce only partial reduction with subsequent speedy relapse. The following figures from Gibson's list¹ will serve to emphasise this important point. 91 per cent of the cases treated within the first twenty-four hours were reducible on abdominal section whereas only 61 per cent of those treated on the third day were reducible. The proportion reducible by distension would necessarily have been less than the above in each case. The mortality of intussusception was greatly reduced when caeliotomy became the primary and routine treatment.

Operation. This should be conducted with as much speed as is consistent with safety; the child should be exposed as little as possible; the limbs are warmly clad and all preparations are completed before the anæsthetic is administered. Plenty of sutures are threaded ready for immediate use for every moment of time saved is of value and the prognosis varies inversely with the length of time that the patient is upon the operating table. All aseptic towels used are dry and warm so that the child may not be chilled by evaporation; the table and operating room are warm.

An incision about two and a half inches long is made over the right rectus muscle; the centre of the wound is about three quarters of an inch below and to the right of the umbilicus.²

This incision gives better access to the seat of origin of the great majority of intussusceptions in children for they nearly all start near the cæcum to whatever variety ingenious classification may refer them.

The reduction of the most difficult part can thus be performed within sight—a very important thing.

The rectus sheath is incised and one edge of it is rapidly raised from the muscle to facilitate overlapping later on. The muscle fibres are separated by blunt dissection to avoid delay from hæmorrhage if possible. The posterior layer of the rectus sheath and the attached peritoneum are incised to the extent of two inches and an attempt is then made to discover the intussusception and to hook it into the wound by means of one or two fingers. In most cases this is not possible for the mass is usually tethered back to the spine by the invaginated mesentery. In these cases the peritoneal incision must be enlarged and then most of the reduction can be easily and safely performed within the abdomen, the finger and thumb gently compressing the distal part of the tumour, which is pushed towards the proximal end at the same time.

In some cases I have been able to reduce the greater part of the invagination by bimanual compression, the intussusception being squeezed between the fingers of the right hand within and the left hand outside the abdomen. Care must be taken to prevent the escape of coils of small intestine for it may be very difficult to replace them and much valuable time may be thus wasted. Moreover, shock is greatly increased by the

¹ *Loc. supra cit.*

² See Cuthbert Wallsee, *Clin. Soc. Trans.*, xxxviii. 50

exposure, traction on the mesenteric plexuses and the manipulations necessary for reduction.

Early and small invaginations may be brought into the wound at once, and towards the end all reductions can and should be performed with the aid of sight; otherwise serious damage may be done to the bowel. This part of the reduction must be conducted with care, and traction on the entering intestine must not be made, except with the utmost gentleness; the ensheathing layer should be fixed below the presenting point, and then it will be usually found that pushing or backing out the contained bowel by gentle squeezing movements between the finger and thumb, these being gradually shifted along the gut, will prove successful, when by no force that is justifiable could any part be drawn out.

Whichever method is found to answer best must be persevered with until every atom of the mass is reduced, this being often known by the appearance of the vermiform appendix. Care must be taken to avoid leaving unreduced the apex of the intussusception, which is often in the ileum about two inches from the cæcum. This part may project into the colon after the cæcum and appendix have resumed their natural positions. I believe this error to be the cause of so-called early recurrences.

If, when the reduction is complete, any tears are noticed in the peritoneal coat, these must be sewn up with a fine continuous suture, and any thin or grey lines should be inverted by Lembert sutures to prevent perforation or infection and to avoid the need of enterectomy in some cases. To prevent recurrence, if time permits, Sir Berkeley Moynihan sometimes passes a few sutures uniting the cæcum and the peritoneum of the right iliac fossa,¹ and with the same object Dr. McGregor² pleats and shortens the lengthened mesentery of an enteric intussusception with a continuous catgut suture running parallel to the bowel. Fortunately true recurrence is very rare after complete reduction. The starting-point is palpated for a possible polyp or inverted Meckel's diverticulum. If either of these be found it must be removed through a small longitudinal incision to be later closed transversely. This was successfully done for an infant by my friend, Mr. O. V. Payne, of Alton, some years ago. Mr. Rutherford Morison³ has successfully removed a Meckel's diverticulum in a similar way from a boy aged 5, thirty-four hours after the onset of symptoms. Payne successfully resected the lower end of the ileum containing an adenomatous polyp in a man aged 62, the subject of chronic intussusception. H. W. Horn⁴ has recorded an example of intussusception of the appendix due to a papillary adenoma, and A. J. Blaxland⁵ a similar inversion due to carcinoma of the appendix. F. F. Burghard⁶ removed from the anus an inverted appendix forming the "leading polyp" of an intussusception.

The wound should be rapidly closed by means of a continuous catgut suture for the peritoneum and deeper fibres of the rectus and interrupted fishing-gut sutures for the remaining layers. When the wound is sewn up

¹ *Abdominal Operations*, 3rd ed., ii, 116

² Moynihan, *loc. cit.*

³ *Lancet*, 1902, 1, 1689.

⁴ *Ann. of Surg.*, 1925, lxxxi, 1002.

⁵ *Brit. Journ. Surg.*, 1920, viii, 227

⁶ *Ibid.*, 1914, i, 721.

in layers without the aid of these supporting sutures there is some risk that it may reopen allowing the intestines to escape. This happened to two of three cases in which Sir Cuthbert Wallace relied upon three layers of catgut sutures.¹

A warm saline enema may be given immediately after the patient has returned to bed and every effort must be made to prevent and combat shock both during and after the operation. Saline infusions are given into the cellular tissues of the axillæ and 5 per cent glucose solutions per rectum.

Feeding with diluted milk and albumen water should be commenced as soon as possible after the operation as long as vomiting does not occur for starvation is one of the serious factors in these cases. Breast feeding is adopted whenever possible. No purgative is given. The bowels generally act naturally within two days if not a water enema is administered.

Irreducible Intussusception. When the intussusception cannot be reduced all attempts at traction and kneading only causing tears in the peritoneal coat the following courses are open according to the condition of the patient &c (1) entero anastomosis (2) resection (a) of the whole intussusception (b) of the intussusceptum (c) with enterostomy, (3) enterostomy (4) anal resection.

(1) *Entero-anastomosis* If the invagination is irreducible but not gangrenous it may be left and the continuity of the canal restored by short-circuiting the small and large intestine above and below the invagination. In a few chronic cases resection may be required after the acute obstruction has been relieved.

(2) *Resection* (a) If the intussusception is gangrenous it should be resected. Some difficulty must be expected in effecting exact axial union in the common variety the ileo-cæcal owing to the difference of the sizes of the two parts of the bowel but this disparity can be overcome by dividing the ileum obliquely removing less of the mesenteric border so that a good blood supply is preserved. Another excellent plan is to close the distal end and to implant the obliquely divided proximal end in the side of the distal bowel. (b) Where the patient's condition is good and the sheath is viable especially in chronic cases an irreducible intussusception is best treated by an operation based by Mr Jessett² on what is known as spontaneous cure. It was three times performed successfully on dogs. An invagination having been made artificially and found a week later firmly adherent it was thus removed. A longitudinal opening was made into the intestine over the root of the intussusception on the side farthest from the mesentery about an inch and a half long of sufficient length to allow the invaginated part to be drawn out with vulsellum forceps. The root of the invaginated part having been pulled out through the above opening was cut through close to its origin any vessel which required it being tied. Then the divided coats where the intussusception had been cut away were united with a few points of suture the lumen of the bowel being left open (see Fig 212). The stump was then returned into the intestine and the incision in this closed by

¹ Loc cit

² Surg Dis of Stomach and Intestines p 140

quilt sutures. Greig Smith¹ recommended this method of treatment, but modified the operation in cases of extensive invagination in that he removed only the apex of the intussusceptum, this being the most swollen part and therefore the chief obstacle to reduction. The rest was then gently reduced. Although reduction will be rendered possible in some cases by removal of the apex of the intussusceptum, in others the adhesion of the layers at the neck of the intussusception to one another will make reduction impossible. In such cases, a more complete resection of the intussusceptum will be necessary. Israel² advocates a modification of

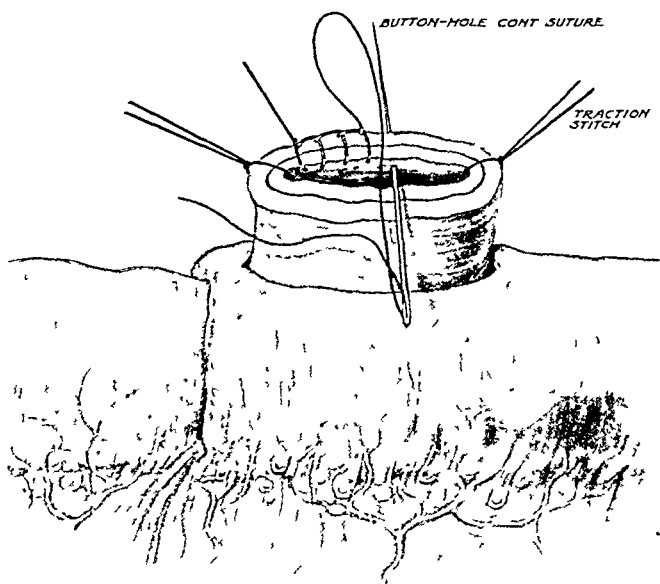


FIG. 212. Jessett's method of excision of gangrenous intussusception through the wall of the ensheathing bowel. The stump is sewn as in Maunsell's operation and withdrawn, and the longitudinal incision closed in the usual way.

the method just described ; he first fixes the intussusception to the parietal peritoneum and then resects the invagination through a longitudinal incision, which is now extra-peritoneal ; the incision in the bowel is left open for a few days for drainage. Israel has had two successful cases with this operation. Other and less desirable methods which may be thrust on the surgeon, owing to the circumstances under which he operates, are : (c) *Resection and valvular enterostomy, cæcostomy or appendicostomy*. C. B. Keetley³ recommended the latter as a means of drainage, feeding and the prevention of recurrence, for in late cases drainage for a few days is essential to success.

(3) *Valvular enterostomy without resection may be the only resort in bad cases*, but it is not suitable where gangrene is evident or anticipated. Secondary resection can be performed after four or five days (p. 268).

(4) *Anal resection*. In rare cases of invagination of the colon into the rectum, the intussusception may be drawn down and removed by the

¹ *Abdom. Surg.*, p. 676.

² *Med. Record*, May 20, 1905.

³ *Brit Med. Journ.*, 1905, ii, 863

operations of Mikulicz or A. L. Barker in this country.¹ In both cases a malignant growth was the cause of the invagination and in each operation the steps were facilitated by the ease with which the growth after dilatation of the anus could be pulled outside. Two rows of sutures were made to encircle the bowel and to unite the two layers of the intussusception firmly together well above the new growth. As the sutures were passed care was taken that no small intestines protruded. Both cases recovered and the first was alive four or five years after the operation. The writer performed a similar operation for an impacted intussusception of a carcinoma which could be neither drawn out of the anus nor back into the abdomen. The anus was slit backwards sufficiently for a successful resection to be carried out. For over two years the patient was in perfect health but he soon afterwards returned with an irremovable growth in the anal scar extending deeply into the pelvic floor.²

Mortality In considering this it must be remembered that every recovery means a life saved from almost certain death. Earlier diagnosis and above all earlier resort to primary operation have greatly improved the prognosis. Sir Cuthbert Wallace³ recorded twenty consecutive cases with only four deaths a mortality of only 20 per cent or excluding the cases severe and late enough to require resection 11.11 per cent. The average duration of the operation in eleven cases was fourteen minutes. This list included one of resection and also one of excision of a gangrenous appendix.

Clubbe⁴ gives an account of 100 consecutive laparotomies for intussusception. Of the first fifty twenty five died whereas of the last fifty only twelve died owing to the children being sent into the hospital earlier and to improvement in treatment. In the first fifty cases the average duration of time before operation in the successful cases was twenty eight hours in the unsuccessful sixty eight hours. In the second fifty cases the average duration was twenty three hours for the successful and forty eight for the unsuccessful cases.

J. L. Adams⁵ discussed 100 cases occurring at St. Thomas's Hospital during the previous eighteen years. Of ninety one treated by operation 35 per cent died.

At the London Hospital⁶ the mortality fell from 56.7 per cent in 1903-1905 inclusive to 17.9 per cent in 1915-1917 chiefly owing to earlier operation but it rose again to 39.1 per cent in 1918-1919 chiefly on account of the delay in admission and treatment owing to the War. The mortality in 400 cases treated in eighteen years was 34.75.

Mr. B. L. Laver analysed the Guy's Hospital results for the five years 1920-1924 inclusive and found the mortality of eighty nine operations to be just under 18 per cent. These operations included four resections, one lateral anastomosis and one enterostomy.

R. W. Bolling⁷ had a mortality of 30 per cent in fifty one operations on fifty patients under a year old.

¹ *Mel Chir Trans* 1887 lxx 335 and *Brit Med Journ* 1897 ii 1971

² *Med Press & Circ* 1910

³ *Clin Soc Trans* 1900 xxxviii 59

⁴ *Brit Med Journ*, January 17 1900

⁵ *Pract* 1910 lxxxiv 679

⁶ W. S. Pettit and E. C. Lindsay *Brit. Journ Surg* 1921 ix 46

⁷ *Ann of Surg* 1903 lxxviii 349

Recovery after resection of a gangrenous intussusception is a very rare event. Thus Gibson¹ in his collection of 1000 cases of intestinal obstruction found only one case of recovery after resection for this condition. In an earlier collection in 1897 there were 239 cases of intussusception, with no recovery from *irreducible* intussusception in a patient under seven years of age, and only nine in older people.

C. N. Dowd² has collected eight cases of successful resection in infants under a year old. Perrin and Lindsay³ found nine successes out of twenty-nine resections with direct anastomosis at the London Hospital, but the youngest of these was three years old. Out of twenty other cases of resection by the Paul's tube or Murphy button none recovered.

The chief hope of the future lies not in successful resection but in less frequent need of that operation, which must always have a high mortality in these cases. In chronic or subacute cases in older patients recovery after resection is not so rare.

Sir Watson Cheyne recorded a successful case of resection of a chronic intussusception which was due to invagination of Meckel's diverticulum, and he refers to another case.⁴

Many of the deaths after operation for this condition are due to toxæmia with hyperpyrexia; some are due to gangrene of the bowel.

III. Volvulus. The intestine here is usually either twisted on its mesenteric axis or bent at an angle. The first is the acuter condition, owing to the strangulation of vessels. It is usually met with in the sigmoid flexure, when this has a long narrow mesocolon, especially in adults who have been subject to constipation (Treves). The distension is usually enormous, the sigmoid appearing to occupy the whole abdomen. Fortunately the twisted loop often contains gas with only little faecal matter; this is due to the obstruction of both ends of the loop, with partial obstruction of its blood-vessels. The author has had several cases of acute volvulus of the sigmoid. One of them is related in full.

VOLVULUS OF THE SIGMOID COLON.⁵ A frail old lady, aged 81 years, a lifelong sufferer from chronic constipation, had since 1900 had several attacks of acute obstruction. These attacks generally passed off in a day or two, leaving the patient quite well again. About 1903 the rectum prolapsed to a great extent and could not be reduced. The patient was in a very grave condition when Dr. C. C. Stead opened the abdomen and drew the bowel back and fixed it to the abdominal wall with a few sutures. Since then the patient has had the attacks of abdominal pain as before, and in 1907 she had a very severe one, during which a ventral hernia at the site of the operation was very tight. It was thought that an operation would be necessary, but fortunately the hernia was reduced and the symptoms abated. Since the summer of 1908 the patient had been a good deal better and able to enjoy life. I was called to see her on the afternoon of July 14, 1910.

History of Attack. Early in the afternoon of July 11 she was seized with severe abdominal pain a good deal worse than her usual attacks. The pain was difficult to locate, but it was mostly about the navel. The bowels had not been opened in spite of numerous enemata and a variety of purges. She had not been sick once but had taken very little food. The pain had been coming on in spasms and had been so severe that the patient could not sleep on the nights of the 11th, 12th and 13th. The abdomen had become more and more distended. A long rectal tube, which she had been in the habit of passing, did not relieve her. Another doctor

¹ *Ann. of Surg.*, 1900, xxxii, 497.

² *Ann. of Surg.*, 1913, lvii, 715.

³ *Loc. supra cit.*

⁴ *Ann. of Surg.*, 1904, xi, 796.

⁵ *Guy's Hosp. Gazette*, November 11, 1911.

was called in in consultation. It was then decided to have a further consultation with a view to operation. When I saw her three days after the onset of the attack the pulse was fairly good, 108 and regular, although it had intermitted earlier in the day, and some champagne had been given. The temperature was normal. The breathing was wheezy and 36 per minute, due to subacute bronchitis. The abdomen was enormously distended and tender in the lower part especially towards the left. A very large coil could be seen extending obliquely across the lower part on the left side from the region of the hernia under the left rectus. At this spot there was a hard swelling. There was no dullness in the flanks and no tenderness in the upper part of the abdomen. Nothing abnormal could be felt from the rectum. An operation was advised.

Operation. This was performed at 7 P.M. under chloroform. A semicircular incision was made across the lower part of the abdomen towards the left side. The hernial sac was opened and showed omentum only. This was not strangulated. There was free serous fluid in the abdominal cavity. The opening was enlarged downwards through the left rectus, and a hugely distended coil of large intestine was discovered. This proved to be the sigmoid. On passing the hand downwards to the pelvis in search of a possible growth the shortened ridges of a twisted mesocolon could be felt. The distended coil extended upwards and to the left, touching the liver and the right flank and also occupying the right iliac fossa. A vain attempt was made to undo the twist without bringing the bowel out. A dense short adhesion was found between the loop and the left edge of the hernial orifice. This was tied and divided. While bringing the bowel out the distension of the projecting part increased so that the peritoneum began to crack, allowing the mucosa to project just like the inner tube of a bicycle. To prevent extensive rupture a large cutting needle was at once thrust through a longitudinal band with the result that a large amount of gas, but no feces escaped. The loop was then empty except for a few scybala. The small puncture was closed by a purse-string reinforced by means of a Lambert suture. The bowel was untwisted, washed and replaced in the abdomen, care being taken to push the proximal limb of the loop as high up as possible. What had been taken to be the upper part of the loop proved to be the lower, when the bowel was traced down into the rectum and the perforation which had been made near the adhesion was found to be near the upper part of the loop. The length of the twisted loop was about three feet and its circumference was about fifteen inches. It consisted only of the sigmoid, the descending and transverse colon and the caecum being almost natural, and the small intestine was very little if at all distended. The meso-sigmoid was of great length and infiltrated with blood. One and a half rotations of it had occurred. The muscular wall of the bowel was greatly hypertrophied, clearly showing that the condition had existed in an incomplete state for a very long time. The peritoneal coat was inflamed and sticky but no pus could be seen. The patient was so ill that there was no time to attempt to fix the bowel to the back wall of the abdomen. All that could be done was to place it in as good a position as possible, and then to bandage the abdomen very tightly. The parietal wound was rapidly closed. The operation lasted half an hour. The bowels were freely opened early next morning. The patient made a rapid recovery and remained well for nearly ten years after the operation.

In the case of a lady aged 61 a colostomy was performed twice within six years for volvulus of the sigmoid loop, each time the colostomy closed spontaneously.

In another acute case, in a middle aged epileptic the writer made an entero-anastomosis, joining the bowel above and below the obstruction and using a tube passed from the anus through the stoma. The patient has remained well for several years.

In other instances acute obstruction has been tided over, either with or without the aid of a rectal tube passed up into the iliac colon when the abdomen has been opened. Subsequent resection of the affected loop has been easy and successful.

The next most common site is the caecum. Occasionally the small intestine is the part involved. Ulceration leading to fatal peritonitis may set in either in the twisted loop or in distended bowel above the obstruction, especially in the caecum when the sigmoid is obstructed.

Sir George Makins¹ believes that volvulus of the caecum is far commoner than is generally considered, and he records a typical and interesting case :

¹ *Lancet*, 1904, i, 159.

The patient was a woman, 67 years of age. During the previous eighteen months she had been the subject of four or five distinct attacks of abdominal pain, accompanied by vomiting sufficiently severe to confine her to bed. Ten days prior to her admission to hospital she was seized with severe pain in the lower abdomen, most acute in the region of the umbilicus. Obstruction of the bowels had been complete for six days, vomiting had been frequent and neither flatus or fæces had been passed per rectum. On admission the woman looked anxious and ill; vomiting of dark fæculent, smelling fluid was frequent. Constipation was absolute. Her tongue was furred but not very dry. Her pulse-rate was 108, and her temperature was 97° F. Her abdomen was considerably distended; the prominence was median, and on inspection gave the impression of a tumour rising from the pelvis. It was resonant throughout except in the right flank.

An operation having been decided upon, the abdomen was opened through the right rectus from just above the level of the umbilicus downwards. A hugely ballooned piece of bowel was at once disclosed, occupying the whole field of operation. The incision was enlarged, but the distended gut could not be delivered, as it was tightly wedged into the pelvis. A trocar and cannula were therefore introduced, and a large quantity of gas and liquid fæces was evacuated. The slackening of the tumour thus produced allowed of the hand being inserted into the pelvis beneath the sac, and the piece of bowel was brought out. The intestine affected proved to be the cæcum and lower part of the ascending colon, which was provided with an unusually long mesentery. The twist was through half a circle, and involved the ascending colon about the centre of its length. The ileum remained viable. It was considered advisable completely to empty the loaded bowel, which was then readily replaced, the two punctures having been securely sutured. The patient made an uneventful recovery, the bowels acted spontaneously the day after the operation, and the stitches were removed from the abdominal wound on the eighth day. On the fourteenth day a localised collection of pus was evacuated from the lower part of the wound in the abdominal wall, and at the end of a month the patient left the hospital recovered.

Corner and Sargent¹ have collected and analysed fifty-seven cases, including their own. They lay stress on the fact that not all the cases are acute, but that chronic and subacute varieties exist. Before the final complete obstruction, many of the patients suffer from constipation and paroxysms of pain in the right iliac fossa, which may be mistaken for appendicular colic because fever is absent. In some cases there is a history of a previous and milder attack of intestinal obstruction. The cæcum and the ascending colon may be unduly loose, and the mesentery of the ileum unduly long, with narrow attachment. Rotation may occur upon the root of the mesentery and the superior mesenteric artery, upon the lower part of the mesenteric attachment or upon the vertical axis of the cæcum and colon.

In the majority of cases the distended cæcum travels upward and to the left behind the root of the mesentery and may be found near the spleen; in others it may lie in the lumbar region or fall into the true pelvis.

Hilton Fagge in his classical paper on intestinal obstruction described two interesting subacute or chronic cases many years ago.²

In recent years many surgeons have discovered this condition during an exploration for acute or subacute obstruction. It is three times more common in males than in females.

The following points are noteworthy in the diagnosis and treatment of volvulus. It is usual for the abdomen to become enormously distended in a short time, and for a hugely distended coil to be visible when

¹ *Ann of Surg.*, 1905, xli, 63.

² *Guy's Hospital Reports*, xiv.

the abdomen is watched for peristalsis. It is not uncommon for this form of obstruction to follow an injury,¹ some loop of bowel distended with feces and with a long mesentery probably becoming suddenly displaced and unable to recover itself. It may follow an abdominal operation. The writer remembers and saw operations upon such a case years ago. The first was for a ruptured left tubal pregnancy with grave hemorrhage; the second was too late a few days later for a volvulus of the sigmoid which had not been replaced in the pelvis at the end of a hurried operation. Again this form of obstruction has been noticed, whether as a mere coincidence or not, in many cases in the insane. It is probably due to the prevalence of chronic constipation in these patients.

Finally at the time of treatment Sir F. Treves's warning² must always be remembered. The reduction of a volvulus does not usually remove the anatomical condition that led to it. The truth of this is shown by their tendency to recur.

Thus the late Mr. Greig Smith³ described a case of volvulus of the small intestine which recurred a week after it had been untwisted by abdominal section. Interoctomy was then performed and the patient for some time wore a catheter in the opening to allow of the passage of flatus into a bottle which he carried in his pocket. After some time the distended bowel had so contracted that the use of the catheter could be dispensed with. Dr. Finney reports⁴ a case of volvulus which involved the whole colon between the ileocecal valve and the sigmoid; it was rectified by operation and recurred nearly three years later. A second recovery followed.

Whiting⁵ relates two cases of volvulus of the whole of the jejunum and ileum. One of the patients, a boy of 5, was moribund at the time of the operation; the other, a man of 34, recovered.

Tully Vaughn⁶ has collected twenty-one cases of volvulus of the small intestines; seven of these were submitted to operation and fourteen recovered. In several cases the difficulties were so great and the appearances so puzzling that the operators did not recognize the condition during the operation. The writer operated for volvulus of the small intestine developing fourteen years after colectomy for chronic constipation; the patient died a month later from granular kidney and uremia.

J. B. Roberts⁷ records a case of volvulus of a part of the ileum complicating typhoid fever; the patient recovered. He also refers to two other cases in which the lesion was only discovered at the autopsy (*Eastw.*). In another case volvulus followed caeliotomy for a perforated typhoid ulcer; the patient recovered from the two operations.

Magruder⁸ discusses volvulus and records a successful case of resection of a volvulus of the ileum in a patient aged 25.

I. T. Stewart⁹ records one case and presents an analysis of eight other cases of volvulus of the great omentum, but in none of these was

¹ See cases mentioned by Mr. Turner, Dr. F. Hawkins and Mr. Staveland (*Lancet* 1897, ii, 993); a case successfully operated on by Mr. Silcock (*Clin. Soc. Trans.* xxviii, 180). References are made in the latter paper to eight successful cases operated on abroad.

² *Oper. Surg.* ii, 330.

³ *Abdom. Surg.* p. 400.

⁴ *Johns Hopkins Hosp. Bull.* March 1893.

⁵ *Ann. of Surg.* 1904, xxxix, 1036.

⁶ *Journ. Amer. Med. Assoc.* May 1903.

⁷ *Ann. of Surg.* 1906, xi, 219.

⁸ *Surg. Gyn. and Obst.* December 1911.

⁹ *Journ. Amer. Med. Assoc.*, March 19, 1904.

intestinal obstruction diagnosed. In five of them the omentum was connected with a hernia, and a diagnosis of strangulated hernia was arrived at in two of these. Four of the patients were thought to be suffering from appendicitis.

Treatment. A free paramedian incision will be required here, so as to enable the surgeon to get at the root of the volvulus, so that he can reduce the latter and take steps to prevent its recurrence by fixing, draining, short-circuiting or excising the affected loop. The volvulus may present at once as a hugely distended coil; or its twisted base may simulate a band and a band may actually complicate the case, as when a vermiform appendix is coiled round the root of the twist of the volvulus.¹ If attempts at *reduction* fail, the volvulus should be emptied with a trocar and cannula, with rubber tube attached, near the summit of the loop brought outside the abdomen if possible and surrounded with gauze packing. When the loop has been emptied as far as possible and the perforation closed with a purse-string suture, further attempts at reduction should be made, and they will generally succeed.

Fixation.—The coil should be fixed to the parietes to prevent recurrence of the trouble. This is best done by suturing the loop and its mesentery to the postero-lateral wall of the abdomen. Care must be taken not to insert sutures near the course of the ureter or the iliac vessels or other structures of importance on the posterior wall. No potential hernial cavity or orifice must be made by leaving a gap or fossa between the loop and the parietal peritoneum. Shortening or *plication* of the mesocolon, as advocated by Prof. Senn, may be tried to prevent recurrence, but care must be taken to avoid interference with the blood supply of the bowel.

Mr. Maunsell's method of fixing the reduced cæcum by performing *appendicostomy* has much to recommend it, for not only is the cæcum drained of its poisonous products for as long as may be thought desirable, but the fistula can be closed practically without risk at any time (*see p. 288*).

Valvular cæcostomy drains the cæcum better and closes spontaneously when the tube is left out. The drained bowel soon shrinks and regains its tone.

Plication of the cæcum has been adopted to lessen the size of the viscus and prevent recurrence;² but, judging by the temporary nature of the results of gastroplication, this does not seem to be a very reliable way of preventing recurrence.

In some cases, small gangrenous areas or grey thin lines may be seen; and these may be inverted, as recommended by Makins.³ In some sigmoid cases colostomy may be avoided and early recurrence may be prevented by passing a long rectal tube through the anus and well into the dilated bowel before the abdomen is closed. If the loop is gangrenous, it should be resected as rapidly as may be, and after the contents of the bowel above the obstruction have been evacuated end to end anastomosis should be performed by direct suture, over a tube draining the colon and passing out at the anus. In bad cases Paul's tubes are tied in temporarily, the anastomosis being deferred.

¹ *Brit. Med. Journ.*, 1892, ii, 170.

² Corner and Sargent, *loc. cit.*

³ *Clin. Soc. Trans.*, 1903, xxxvi, 183.

If the volvulus be merely irreducible a temporary artificial anus may be made above the twisted loop which has been first completely emptied and securely closed. Although this plan may be successful in some cases it should not be resorted to until every reasonable effort has been made to untwist the coil or in patients who are in *extremis*.

Resection—In some cases where the volvulus is persistent recurrent or irreducible or where a faecal fistula persists excision of the twisted loop is the best treatment and whenever possible this should be performed during a quiescent period in the absence of distension of the dilated and twisted loop and in the absence of obstruction of the bowel above.

Lateral anastomosis of the extremities of the loop as advised by Braun may be suitable for some cases. Anastomosis between the transverse colon and the descending loop of the pelvic colon may be of service in some rare and irreducible cases.

Sir Berkeley Moynihan¹ records several interesting examples of volvulus especially Case 4 where a recurrent volvulus of the sigmoid was successfully resected. He also relates a case of *compound volvulus* of the ileum and sigmoid in which the two loops had intertwined.

The mortality of volvulus is very high. Thus in Corner and Sargent's collection of fifty seven cases nineteen recovered and twenty one died after operation the remainder died without operation. In the records of Guy's Hospital for the five years 1920-1924 Mr B. L. Laver found eleven cases of volvulus six of the small and five of the large intestine with five deaths a mortality of 45 per cent. The mortality for seven large Hospitals for the same period was 51 per cent in 74 cases. Quick and efficient work and drainage of the distended loop and of the intestines above the obstruction are very important elements in the success of the operation.

IV Gallstones, Intestinal Calculi, &c Gallstones the most common of these present crises very favourable for operation if taken in time owing to the simplicity of the cause of obstruction and the facility with which it may be usually dealt with but operation has been here too often deferred because these patients usually advanced in life and stout are not considered well suited to operation from a general point of view, and especially because the final attack of intestinal obstruction is mistaken for a severe bout of biliary colic with which the patient and his medical attendant are generally too familiar. Occasionally the stone passes and spontaneous recovery ensues. The faint hope of this happy issue has unfortunately accounted for many deaths from delay. Sir F. Treves² states that of twenty cases in which gallstones produced definite and severe symptoms of obstruction six patients recovered by the spontaneous passage of the stone and fourteen died unrelieved.

In some cases in addition to the age sex obesity and habits of the patient the history of previous inflammation in the neighbourhood of the gall bladder may help the diagnosis. More than two thirds of the patients are females and the great majority are over 40 years of age. In four cases certainly the calculus has been felt—the abdomen being undistended—before operation. But in the majority it is probable that

¹ *Abdominal Operations* 3rd ed. p. 133.

² *Intestinal Obstruction* p. 330.

here, as elsewhere, operation alone will demonstrate the cause of the obstruction. Although a gallstone, after ulcerating from the gall-bladder into the duodenum, may become arrested anywhere in the small intestine, it commonly gets impacted near the lower end of the ileum where the bowel is narrowest. A stone having ulcerated directly from the gall-bladder into the colon may get arrested in the narrow sigmoid colon.

Operation. The following courses may be adopted after the stone has been discovered by median laparotomy: (1) Try to pass on the stone through the ileo-cæcal valve into the large intestine. Mr. Clutton¹ succeeded in doing this, the stone being situated eight inches above the valve, but usually the stone is too firmly fixed.

Mr. Clutton's case is a very instructive one. The patient, a woman, aged 70, was operated upon within twenty-four hours of the beginning of the attack. Fifteen months before she had passed a large faceted biliary calculus, and after her recovery from this she had had a swelling in the region of the gall-bladder. This disappeared with the onset of the obstruction. A median incision four inches long having been made, the stone was readily felt, and though it tightly fitted the lumen of the intestine it could be forced along. As, owing to the early date at which the operation was performed, there was no marked difference between the intestine above and below the obstruction, the site of the ileo-cæcal valve was determined by making out the cæcum and the appendix. There was not much difficulty in urging the calculus in the right direction, but as soon as the valve was reached some considerable force was required to make it pass through. This most successful case strongly supports Mr. Clutton's advocacy of an early operation.

(2) If the stone cannot be pushed onwards, and if it is too hard to be broken up by gentle pressure with the finger, it must be removed. The loop of bowel containing the calculus is drawn well outside the abdominal cavity, surrounded with gauze packs and the stone is displaced upwards into more healthy intestine if possible. An assistant fixes the stone by compressing the bowel above and below it, while the surgeon removes it through a longitudinal incision made along the free border of the intestine. Care is taken not to lacerate or bruise the edges of the wound by trying to extract the stone through an incision which is too small. If the intestine above the obstruction is distended, its toxic contents must be evacuated through the incision, care being taken to hold the latter over a basin well away from the wound. The intestine is then thoroughly cleansed, and the incision closed transversely with two continuous sutures of fine catgut (Fig. 222, p. 379).

(3) If the bowel at or just above the stone be gangrenous, it should be resected, and an anastomosis performed immediately after emptying the distended intestine above. If the condition be doubtful, any small grey area may be inverted and the intestine returned just within the abdomen after making a valvular enterostomy.

(4) In some grave cases without gangrene, a temporary valvular enterostomy is made to prevent or overcome paralytic distension.

Mr. S. M. Smith² relates a fatal case of obstruction of the sigmoid flexure by a gallstone which had entered the transverse colon from the gall-bladder; the stone was not discovered at the operation.

Mr. Milward records a similar case, in which he successfully removed a large stone from the sigmoid.³

¹ *Clin. Soc. Trans.*, 1889, xxi, 99.

² *Lancet*, 1905, ii, 1174.

³ *Ibid.*, p. 1327.

Dr Le Conte¹ had to resect a piece of gangrenous small intestine above the stone which had been forced along by purgatives after it had caused injury and infection of the bowel and its mesentery at the site of its original impaction. End-to-end anastomosis was performed at once, but the patient died.

Prognosis From the deceptive nature of the symptoms and often from the incompleteness of the obstruction delay in exploring is far too common and the septic contents of the obstructed bowel are often not removed. It is not surprising therefore that the operation is attended by a high mortality. In Barnard's eight cases² the mortality was 57 per cent. in Courvoisier's 125 cases it was 41 per cent. and of Schneller's eighty-two cases 56 per cent. died. In Eve's twenty collected cases the mortality was 40 per cent. In twenty-eight cases at seven large British hospitals between 1919 and 1925 the mortality was 50 per cent.

V Embolism and Thrombosis of the Mesenteric Vessels or of the Abdominal Aorta Mention must be made of the above conditions as it is clear from the cases published that though rare they may simulate acute intestinal obstruction very closely. The explanation appears to be that a loop of intestine deprived of its blood supply by an embolus or thrombus *will functionally be as completely paralysed as if it had been strangled*. The collateral circulation of the intestines is so poor that gangrene nearly always supervenes and often spreads. Sometimes however, the circulation is re-established allowing spontaneous recovery after exploratory laparotomy which has clearly proved the diagnosis. Instructive cases will be found published by Mr McCarthy³ and Dr Munro, of Middlesbrough.⁴

Dr Munro quotes from Gerhardt and Kussmaul the following diagnostic points of these cases: (1) A source of origin for the embolus. (2) profuse hemorrhage from the bowels. (3) severe colic like pains in the abdomen. (4) rapid reduction of temperature. (5) demonstration of an embolus in some of the other arteries. (6) palpation of infarct in the mesenteries. In Dr Munro's case one of these situated in the mesosigmoid could be felt before operation in the left iliac fossa. Embolism is due to valvular disease or atheroma and thrombosis may start in any infection especially in the portal area and may spread from the portal or splenic veins. Splenic anaemia sometimes proves fatal in this way with or without splenectomy. The mischief is usually too extensive to admit of surgical interference. *If it be limited to the small intestine, several branches are usually plugged. Complete obstruction with the usual symptoms and much distension develop later on.*

The recorded cases have almost always ended fatally. In several cases, however, the portions of bowel and mesentery involved were removed with success.

Tyson and Linington⁵ report a case of resection of about a foot of gangrenous small intestine the condition being due to atheromatous embolism of a branch of the superior mesenteric artery in a woman 66 years of age. Considerable difficulty was experienced in getting the

¹ *Ann of Surg* 1902 xxxvi 300

² *Ibid* 1902 xxxvi 161

³ *Lancet* 1890 i 646

⁴ *Ib d* 1894 i 147

⁵ *Clin Soc Trans*, 1902 xxxv 114

stitches to hold in the sodden and friable mesentery, and the patient died.

Jackson, Porter and Quinby¹ have collected and analysed 214 cases of embolism and thrombosis of the mesenteric vessels. They found that blood was passed per anum in only 41 per cent. of the cases. In forty-seven cases operations had been performed, with four recoveries, or a mortality of 92 per cent.

A review of the pathological appearances indicated that in about fifteen of the cases which had not been submitted to operation short resections might have been performed with advantage.

Elliot² describes an interesting case of thrombosis of a part of the superior mesenteric vein leading to gangrene of a loop of jejunum fourteen inches long; this was successfully resected. The thrombosis came on eighteen days after anterior gastro-jejunostomy. J. F. Mitchell³ successfully resected eighteen inches of gangrenous ileum due to mesenteric thrombosis.

Operation. As in all varieties of intestinal obstruction, the only hope is in early operation and resection well beyond the disease. Sometimes great lengths of bowel have to be resected, but complete recovery may follow the removal of more than a third of the small intestine. As a rule it is necessary to drain the intestine in these cases either by valvular enterostomy or by tying in Paul's tubes in the ends of the bowel in grave cases, deferring the anastomosis for a few days only.

¹ *Journ. Amer. Med. Assoc.*, June and July, 1904.

² *Ann. of Surg.*, 1905, xlii, 674.

³ *Ibid.*, 1923, lxxvii, 299.

CHAPTER LVII

INTESTINAL ANASTOMOSIS AND EXCLUSION CLOSURE OF FÆCAL FISTULA AND ARTIFICIAL ANUS. ENTEROPLASTY

INTESTINAL ANASTOMOSIS AND EXCLUSION

THESE operations which are now in common use and of great value in suitable cases, we owe to the originality of Maisonneuve and the laborious experiments of Senn. Their elaboration is largely due to the work of Hartmann, Mikulicz, Salzer, Monprofit, Arbuthnot Lane and others.

Simple Lateral Anastomosis. Here a communication or short circuit is made between the bowel above and below an obstruction or disease, but apart from complete obstruction which is rarely permanent, some of the fæces can still pass through the diseased part for the bowel is not divided or occluded. In the absence of obstruction the side track tends to close unless very large for peristalsis directs most of the contents along the natural passages (see Fig. 213).

Indications. (1) *Chronic obstruction due to growth* either as (a) a permanent measure in preference to colostomy when the growth is irremovable or (b) a preliminary step to resection of the growth. The following cases illustrate (a) and (b) (Figs. 213 and 214).

(a) An old man with inurable growth of the splenic flexure with peritoneal nodules lived over a year after an anastomosis was made between the transverse and

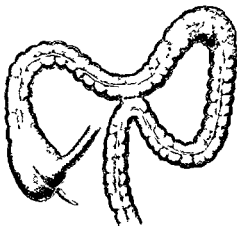


FIG. 213. Lateral anastomosis of transverse to pelvic colon for carcinoma of splenic flexure which was removed later (see Fig. 214 and case (b)).

pelvic colons during acute upon chronic obstruction. The patient was very comfortable and able to continue his important work for nearly a year. He ultimately died almost painlessly from metastases in the liver. In a number of cases I have short circuited similar growths at different parts of the colon. With a growth at the

hepatic flexure experience shows that a lateral ileo-colostomy does not relieve the patient so much as an anastomosis between the cæcum and transverse colon, for some of the contents of the small intestine still continue to pass into the distended cæcum which, as Rutherford Morison has shown, may ulcerate and perforate. This difficulty can be met in another way by narrowing or dividing the ileum below an ileo-costomy.

(b) A lady, aged 54, seen in October, 1919, had been suffering from intestinal obstruction for ten days: the vomit was brown and offensive and the abdomen distended. Upon exploration a carcinoma was found at the splenic flexure of the colon. A short-circuit was made between the middle of the transverse and pelvic colons. Two months later the growth was removed through an oblique incision in the left flank parallel to the intercostal nerves. The swelling had shrivelled considerably and was easily removed, the ends of the colon near the anastomosis being closed without disturbing the stoma. The patient was alive and well six years later.

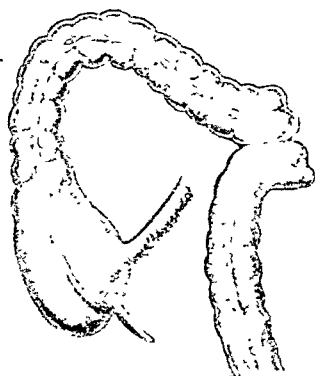


FIG. 214. Lateral anastomosis with secondary resection of splenic flexure of colon (see Fig. 213).

(2) *Chronic obstruction due to other causes* such as fibrous strictures, tuberculosis or other disease of the mesentery, or matting and kinking of the intestine due to inflammatory affections.

For extensive tubular stricture due to ulcerative colitis in a young lady, patient of Dr. A. F. Hurst at New Lodge Clinic, I joined the healthy cæcum to the healthy descending limb of the pelvic colon, with the result that spurious diarrhoea with severe bleeding (ten or more actions in the twenty-four hours) ceased at once, and the patient made a rapid recovery on a full diet (Fig. 215).

(3) *Recurring volvulus*, especially of the pelvic colon. The limbs of the loop have been anastomosed, and similarly Gant has joined the pelvic colon to the front wall of the rectum for kinking at the lower end of the pelvic colon. It is probable that many troublesome cases of constipation, including the so-called congenital dilatation of the colon, may be successfully treated in this way.

(4) *Gangrenous bowel*. The healthy bowel above and below a doubtful or gangrenous loop has been anastomosed, while the loop has been either excised or drained and left in a hernial sac.

(5) Entero-anastomosis has been performed to prevent or cure lateral *regurgitant vomiting*, and has been discussed under gastro-jejunostomy.

(6) Lateral anastomosis has been used as a preliminary step to closing a fecal fistula or artificial anus, but it is not so effective as unilateral exclusion.

Operation. The anastomosis is made as already described at p 155 (Figs 89 to 97) Direct suture is by far the best means of union Here it is well to remember that

(1) The parts to be joined should be as healthy as possible and especially as regards their serous surfaces

(2) There should be no tension upon the sutures therefore only such parts should be joined as can be easily approximated with or without mobilisation

(3) The anastomosis should be made at a suitable distance from the obstruction or disease For instance it should not be so near that the new opening is likely to be invaded by the growth which calls for the

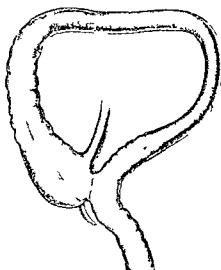


FIG 215 Lateral anastomosis The caecum was joined to the lower part of the pelvic colon for a tubular stricture extending from the hepatic flexure to the middle of the pelvic colon

anastomosis and it should not be so far from the obstruction as to throw an unnecessary length of intestine out of action for stasis and putrefaction to take place

(4) In all cases the tendency to contraction of the new aperture should be remembered and the latter should be made at least three inches long It should be made especially large when joining two parts of the colon, where the contents are solid and peristalsis is poor

(5) Whenever possible the parts should be joined together in an iso peristaltic manner, and in any case care should be taken to avoid kinking by joining the intestines for some distance above and below the anastomosis

(6) Care must be taken by suturing the mesenteries to avoid making bands, apertures or other possible sources of future intestinal obstruction

Unilateral Exclusion Simple lateral anastomosis is not enough in some cases, for it is often desirable to 'exclude' a portion of diseased intestine, so that no faeces can reach it to be retained or cause irritation

and pain. Thus in colitis it is desirable to give the diseased part complete rest. The same is true of some cases of tuberculous and malignant disease of the bowel and chronic obstruction of the colon, due to other causes. In the absence of mechanical obstruction it has been found that the loss of a flushing stream has led to troublesome accumulation in the cæcum after complete division of the ileum in ileo-sigmoidostomy. The accumulation is partly the dried secretion of the large bowel, but chiefly faeces regurgitated from the pelvic colon.

In many cases, this has made it necessary to remove the excluded part of the bowel or to perform appendicostomy or valvular cæcostomy.

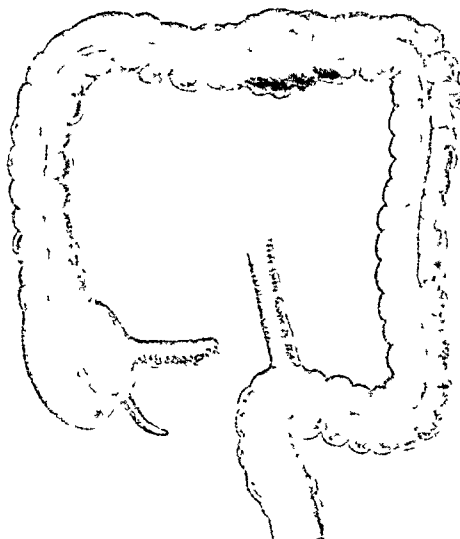


FIG. 216. Unilateral exclusion. The proximal end of the divided ileum has been joined to the pelvic colon and the distal end closed for a cancerous stricture of the colon.

The anastomotic opening is not so likely to close when no alternative passage is left.

Unilateral exclusion involves complete division of the intestine at one point above the disease, with anastomosis or implantation of the proximal end into the side of the healthy intestine below; the distal extremity may be either closed or drained according to the necessity. It is generally closed. For example, the ileum is often divided six inches from the cæcum and the upper segment joined to the colon below an incomplete obstruction, while the distal end is closed (*see* Fig. 216).

The same effect may be produced by ligating the bowel instead of dividing it, and then performing lateral anastomosis between the bowel above the ligature and below the disease. The ligature is buried by a continuous sero-muscular suture, but this is not a good way, the natural channel having been restored in some cases (Fig. 217).

Indication. (1) *Artificial anus* especially in the small intestine, where it is vital to prevent leakage with certainty and without delay. The bowel is divided just above the opening and implanted into the side of

in most cases and further it is easier and takes less time—a point of considerable importance in acute intestinal obstruction.

(5) *Tuberculous disease*, especially of the ileo-cæcal region, when the patient is too ill or the disease too extensive and adherent for resection.

Bilateral Exclusion involves two divisions of the intestine, one above and one below the disease, the proximal and distal ends being joined together to re-establish the channel. The ends of the excluded loop are inverted or drained at one or both extremities. The distal extremity is the best to choose for drainage because peristalsis will help. In case of obstruction, however, the fistula should be proximal to the obstruction. Appendicostomy or valvular cæcostomy may serve to drain an excluded cæcum. Without adequate drainage the excluded bowel is a source of

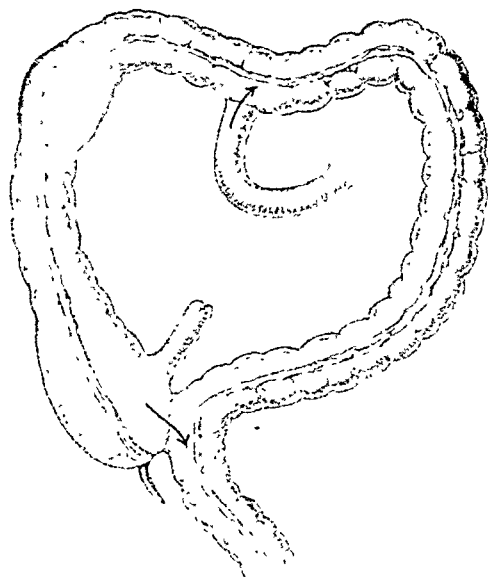


FIG. 218. Exclusion with drainage of cæcum into pelvic colon.

trouble and even danger, for it distends with mucus or pus and may perforate and cause peritonitis.

For these reasons bilateral exclusion is rarely desirable. As a rule, it is better to remove than to leave a completely excluded piece of bowel; but the method is valuable in curing some cases of fistula between different parts of the intestine, or between the bowel and another cavity such as the vagina. In some bad cases it is easier and safer to exclude a small length of intestine than to separate it at the fistula, at least as a temporary measure. Then the excluded loop is drained through the old fistula and may cause no more trouble, but it may become distended with mucus or pus and have to be removed or permanently drained later on.

Whenever possible it is wiser to make provision at the first operation for the permanent drainage of the excluded part of the bowel. Fig 218 is intended to show an irremovable carcinomatous stricture at the hepatic flexure of the colon, the ileum has been divided, the proximal end implanted into the transverse colon, the distal end closed, and the cæcum drained into the pelvic colon, thus avoiding the need of cæcostomy. Lateral anastomosis of the ileum to the transverse or pelvic colon is not so satisfactory in such a case because the contents of the ileum still pass into the cæcum, distending it and causing ulceration and perforation if the ileo cæcal valve is efficient enough to prevent regurgitation into the ileum. Division of the colon between the stricture and the ileo colostomy is to be avoided because the colon just distal to the growth may get distended and burst.

CLOSURE OF FÆCAL FISTULA AND ARTIFICIAL ANUS

Only some of the fæces are discharged through a fistula, but all issue from an artificial anus, none passing through the natural anus. Some of the *points of difference and some of the varieties of unnatural openings* are shown in Fig 219. A fistula is not always on the surface but may communicate between the bowel and a hollow viscus. It may be congenital or acquired through injury, operation, gangrene, suppuration, tuberculous or malignant disease.

Before operating certain points of much practical importance should be considered and first how far any spur or septum is developed. The more marked this is the less the chance of closing the opening by any slight plastic operation such as paring and suturing the edges of the opening. The spur being left behind, the fæces will make their way out again near the sutures, and the longer this condition is allowed to remain the more, of necessity, will the *lower segment of intestine atrophy* and the more marked will be the difference between the two parts of the bowel.

It is of vital importance to find if there is obstruction anywhere below, for if there is the hope of spontaneous cure is remote, and the prospects of a simple plastic operation are very poor. The presence of pus in the fistula is a strong contra-indication to any immediate plastic operation, it is better either to wait a little longer or, in urgent cases, to use indirect treatment by short circuiting or occlusion. Other important points are the nutrition of the patient and the condition of the area surrounding the wound. The higher and the greater the leak in the small intestine the more will the nutrition have suffered and the more urgent the need for an early and radical operation for closing the fistula or artificial anus.

If given time, small fæcal fistulæ, when the mucosa is not attached to the skin, usually close spontaneously, especially if the fistulous track is long and lined with granulations, but the higher the fistula the more liquid and irritating the discharges and the less clear the channel below it, the less likely is it to heal. Fistulæ of the colon often close, and even a complete artificial anus with a spur may sink in and close spontaneously. Formerly the cautery was used to freshen the edges of callous fistulæ, and sometimes this led to healing by granulation.

A. Operations for Fæcal Fistula. (i) *Early Operation.* Valvular enterostomy or cæcostomy, in the absence of obstruction below it, usually closes spontaneously, often a few days after the tube has been removed. A fistula that is not valvular, if it leaks freely, often needs early closure as soon as it has served its purpose. It is easier to close it at this stage, for no dense adhesions have formed, no serious changes have taken

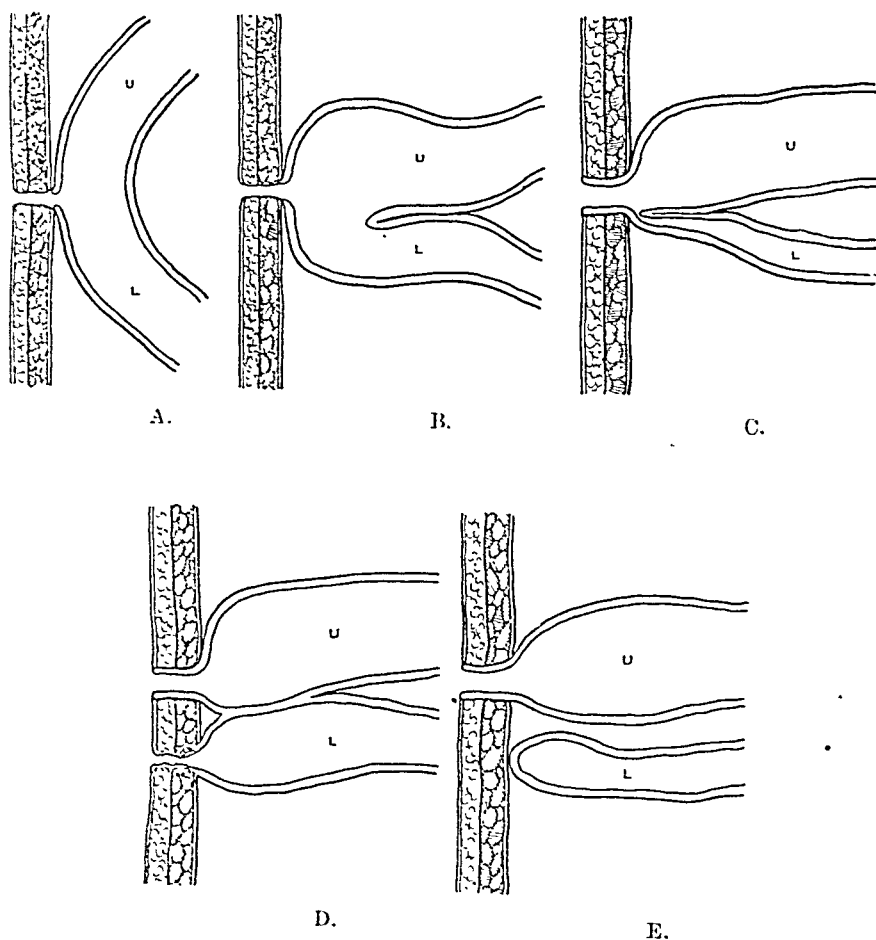


FIG. 219. U. Upper bowel. L. Lower bowel. A. Fæcal fistula without kinking or spur formation. The opening is usually small. B. There are kinking and spurring. C. Artificial anus with valvular spur. D. Artificial anus. The upper and lower bowels open separately on the skin. E. Artificial anus; here the lower bowel is closed.

place in the bowel near or below the fistula and the parietal wound has not contracted. It is important to replace the sutured part amongst supporting coils of small intestine and to cover it with omentum.

The opening, if small, is closed with a piercing purse-string suture of fine catgut and this is supported by a serous suture of the same material; if of considerable size two sutures are passed as usual, the deep one being a Connell and the serous one a Cushing. The suture-line is transverse

to the axis of the bowel. The parietal wound is almost completely closed usually with interrupted piercing sutures of fishing gut. No drain is placed near the sutured bowel.

(ii) *Extraperitoneal operation*. In all these later operations it is most important to empty the bowel above and below the fistula and to feed the patient on a diet leaving little residue for two days before the operation. The skin should be made as healthy as possible by dressing with suitable protective ointments or the application of a fenestrated rubber apron fixed near the edges of the fistula with rubber solution or the introduction of an effective tube to conduct the discharges away.

Extraperitoneal operations often failed especially when the fistula was in the small intestine partly because the separation of the edges was not free enough owing to the operator's dread of opening the peritoneum and chiefly because serous surfaces could not be apposed. Greig Smith tried to get over these difficulties by wider dissections. An elliptical

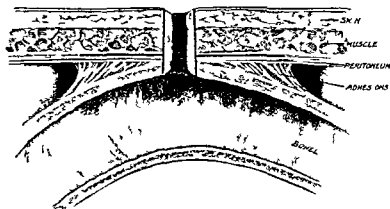


FIG. 220. Extraperitoneal closure of fecal fistula. The horizontal lines show the course of the incision which mobilise the parietal peritoneum.

incision is made passing near the margins of the fistula and continued upwards and downwards for about two inches. The edges of the fistula are thoroughly separated and securely sewn together to prevent leakage during the following stages. The extremities of the incision are deepened until the extraperitoneal fat is reached and the parietal peritoneum is separated from the abdominal wall all round the fistula for at least two inches (see Fig. 220). This step will be best carried out by commencing the separation at the extremities of the incision which are most remote from the fistula and working towards the latter. In this way the proper layer is more easily and safely found. The bowel with the loosened peritoneum can now be lifted out through the incision in the parietes. If there is any difficulty in doing this a little more detachment will make it easy. The fistulous track is now cut away down to the level of the bowel and the opening in the latter is closed with continuous Connell and Cushing sutures of fine linen thread. The line of suture must be transverse to the axis of the bowel so that the lumen of the latter is not narrowed. This is especially important when the

opening is a large one (see Fig. 221). The intestine and peritoneum are now replaced and the parietal incision closed. This method may fail from want of removal of unhealthy tissues around the fistula. Moreover, the extraperitoneal fat and the fibrous external surface of the parietal peritoneum are poor substitutes for serous surfaces which unite more quickly and more securely. Narrowing of the lumen, either from kinking, pre-existing spur or improper inversion, may also defeat the object of the operation. When any doubt exists it is better to open the peritoneum freely, so that serous surfaces can be apposed, the bowel thoroughly examined and also clamped to prevent leakage.

(iii) *Intraperitoneal closure without axial resection.* The preparation and preliminary steps are the same. The fistula having been securely sewn the incision above and below it is deepened and the peritoneum opened well away from the fistula. The parietal incision is carried towards and around the fistula until the bowel is free. Care is taken as the fistula is approached on account of adhesions to neighbouring coils,

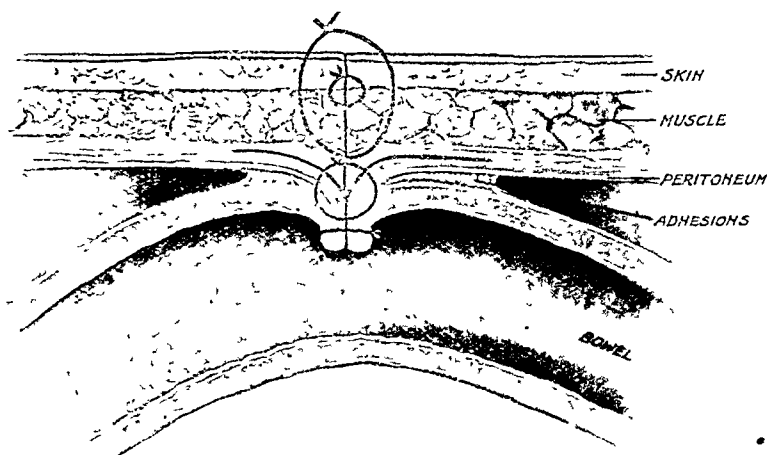


FIG. 221. Extraperitoneal closure of fæcal fistula. Two layers of suture are shown closing the bowel.

which may be flat, kinked and difficult to avoid. The bowel and mesentery are examined to decide whether a partial paring or complete axial resection is the most suitable. If a satisfactory local operation can be done it should be chosen, for it is safer than axial resection. On the other hand, if healthy serous surfaces are difficult to obtain without excising a considerable area of the bowel wall, so that kinking or spurring is likely to occur when the large wound thus made is closed, it is better to resect. Sometimes a definite stricture below the fistula has to be excised. When paring is adopted the affected loop is brought out and packed off with care. Its contents are squeezed up and clamps are applied. The suture is removed and the edges of the opening are pared, the incision being made through healthy tissues with a good serous surface. The margins are picked up with two tissue forceps which serve to make the wound transverse to the axis of the bowel. Two continuous sutures of fine catgut are inserted. The first is a Connell suture and its

knots are placed within the lumen of the bowel. The second is a Cushing serous suture which buries itself better than a Lembert. In this way narrowing of the channel is avoided (see Fig 22¹). With small openings especially in the large intestine there is no need to make the suture line transverse. If the opening is a very long one sewing it up in the transverse direction may lead to kinking and excessive tension upon the suture. The surface is cleaned with moist swabs, the packs are removed and the coil is returned to the abdomen, if possible well away from the wound and amongst other coils. If this is not practicable as in the large intestine the omentum or appendices epiploicæ are brought over the suture line. Whenever possible the parietal wound is closed in layers so as to prevent the formation of ventral hernia.

(iv) *Closure by complete resection.* This is sometimes necessary for fæcal fistula and far more frequently for artificial anus. Makins performed the first successful operation of this kind in England in 1881.¹ The skill with which the operation was performed was only equalled by the thoughtfulness with which it was planned.

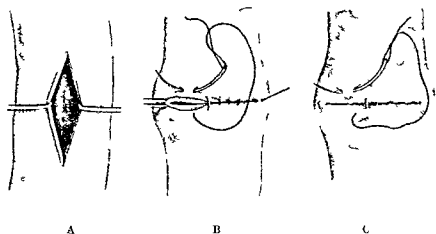


FIG 29. Intraperitoneal closure of fæcal fistula. A The margin of the fistula has been excised and the wound is made transverse by traction. B The opening is closed by a Connell suture. C The Cushing or serous suture is shown.

The first steps of the operation are the same as already described and the details of resection and union have been described in Chap. XX. Axial union is as a rule the best, but when there is any difficulty one of the other methods may be adopted.

(v) In certain cases the methods already described may not be applicable or suitable and in these short circuiting or exclusion may be safer although they may appear at first to be less satisfactory than direct treatment of the fistula. The writer has found this method very satisfactory when a fæcal fistula or artificial anus in the small intestine has led to rapid wasting with excoriation of the skin. A wound at some distance from the fistula is cleaner and fewer adhesions are to be met so that the operation can be completed with greater speed and also with more certainty of healing of the bowel and parietes because the tissues to be sewn are healthier.

The following is a good example of this :

A boy, aged 10, had acute intestinal obstruction following appendicitis, and when seen *in extremis* all that could be done was to make an enterostomy in the distended ileum above a mass of adhesions. The fistula would not heal, and some three weeks later, when the boy was wasting away, the abdomen was re-opened in the hope of removing the cause of obstruction. This hope proved vain, for the lower two feet of ileum and cæcum were hopelessly adherent together and to the pelvis. Therefore the ileum was divided just above the fistula and the obstruction, a small piece of bowel, including the fistula was excised, the cæcal end was tied and inverted, and the proximal end was implanted in the upper part of the sigmoid colon. The anastomosis and the stump were placed amongst neighbouring coils of small intestine and the abdomen was closed. The boy did very well, except that occasionally he had attacks of diarrhœa due to accumulation of scybala in the cæcum. Large enemata and saline purgatives always gave prompt relief. Five years afterwards the patient was seen quite well and strong, and free from all abdominal symptoms.

Tuberculous disease with fistulæ, especially common in the ileo-cæcal region, may be too extensive and adherent or the patient too feeble for resection to be contemplated. Unilateral or bilateral exclusion may then be resorted to and may give much relief if not a complete cure¹ (p. 371).

A fistula in the lower part of the cæcum is best closed by excision of the greater part of the cæcum and suture, without interfering with the ileo-cæcal valve. Duodenal fistula, occasionally following perforation of an ulcer, is best treated by gastro-jejunostomy with occlusion of the pylorus, although temporary jejunostomy is sometimes all that can be done in the marasmic subjects of this high fistula. Fistulæ between the small intestine and the vagina or bladder may be treated by detachment and plastic repair of the opening thus left ; sometimes bilateral exclusion is safer, and the small segment of bowel atrophies and ceases to discharge. Fistulæ between the pelvic colon and the bladder, often associated with diverticulitis, are best treated in a similar way, generally after a preliminary colostomy for safety. Sometimes the affected part of the bowel is resected at the same time as the fistula is closed. Malignant fistulæ between the pelvic colon or rectum and the bladder are best treated by colostomy with a good spur.

B. Closure of Artificial Anus. As long as there is a well-marked or complete spur there is no hope of spontaneous cure, and but little prospect of success from any plastic operation short of resection. When the artificial anus is low down, and especially in the large intestine, some time can be devoted to the abolition of the spur. Sometimes the affected piece of bowel sinks in of its own accord, the spur recedes and the opening closes. The pressure of a truss is very rarely successful and is usually painful. The spur may be destroyed by means of Paul's enterotome, which grips and exerts spring pressure upon the spur. The pressure can be increased at will by means of a screw, and the instrument bites through in three or four days. The kentotribe of Von Mickulicz exerts more gradual elastic pressure and takes several days longer. A similar instrument may be used to make a window through the base of the spur when the two pieces of bowel are in contact for some distance from the aperture. This makes the subsequent operation for closing the fistula much easier

¹ Mr. Roughton (*Lancet*, 1902, ii, 1128) showed a man before the Harveian Society, in whom he had anastomosed the ileum to the ascending colon for tuberculous fistula of the cæcum. No fæcal discharge came through the fistula, which remained open.

and often makes a resection unnecessary. This is the usual method used so successfully by Mr. Paul after resection of growth of the large intestine. He always sews the two parallel tubes of bowel together at the time of the resection, so that the subsequent use of the enterotome is easy and unlikely to grip another piece of intestine (Fig. 201 A and B, p. 320).

The late Sir Mitchell Banks¹ used the following simple and ingenious method, and when the septum or spur is not well developed it may be expected to succeed. Into an artificial anus in the groin after a strangulated femoral hernia he introduced a thick piece of rubber tubing pushing one end up and the other down the bowel. It was secured by a silk suture brought out of the fistula. The elastic pressure of the tubing pressed the spur back and allowed the feces to turn the corner and enter the bowel below the fistula. At the end of seven weeks all the feces passed by the rectum and the sinus in the groin healed within three months. This is a tedious process but a safe one. It is most suitable when the artificial opening is low down and the spur is incomplete. It is often valuable as a preparation for a radical operation, for it serves to prevent atrophy of the lower bowel and to give us information concerning the latter especially when the artificial anus has been made to give rest for ulcerative colitis. If the feces upon reaching the rested bowel again cause recurrence of symptoms it is clearly too soon to attempt to close the artificial anus. It is always a dangerous and troublesome business to close an artificial anus in these cases. One of the operations already described under fecal fistula may be tried and may succeed if the spur has been abolished. Resection or short circuiting has to be adopted if the spur cannot be removed either by preliminary treatment or at the operation.

The following is an example of short circuiting for artificial anus.

The writer excised the lower two feet of the ileum for gangrene resulting from volvulus above a mass of adhesions following a bad attack of appendicitis treated conservatively. The pelvis was full of foul pus. When the cecal end of the ileum had been invaginated the operation had to be abandoned as the patient seemed to be dying. A Paul's tube was hurriedly tied into the open end of the ileum. After repeated infusions and constant attention by the clinical assistant Dr. Darke, the patient rallied. Sixteen days later she was utterly miserable from the intolerable irritation of her abdomen by frequent discharges of the acid contents of the small intestine. She was wasting rapidly. A rubber tube was passed into the fistula for several inches, the fistula and raw surface were covered and an incision was made far above and to the left of the original wound. The part of the ileum containing the tube was immediately identified, tied, clamped and cut across between the ligature and the clamp after packs had been placed. The ligatured terminal end was invaginated with two purse string sutures and the proximal end was implanted into the first part of the transverse colon. The whole operation was completed within fifteen minutes because the patient was so very ill. She made a good recovery and two years later had another baby (the ninth) at the age of forty six although it had seemed that such extensive adhesions were likely to be present in the pelvis as to render the abdominal ostia impervious. Some time later the blinded test tube like piece of lower ileum turned inside out and prolapsed. This was excised.

ENTEROPLASTY

This term has been given to an operation for the relief (short of resection) of strictures of the intestine believed to be innocent. It is

¹ Can. Notes p. 91

based upon the operation of pyloroplasty which used to be performed for stenosis of the pylorus and the first part of the duodenum following upon simple ulceration.

Innocent intestinal strictures are very rare, but they may follow injury or operation, or the healing of tuberculous ulcers of the small or large intestine, or they may follow dysenteric ulceration of the latter. Sargent¹ has related three cases of stricture of the small intestine following strangulated hernia. Mr. Sargent also presented a Table of eighteen collected cases, including his own. In six of these there were two strictures, and most of the single strictures were extensive and not annular. In six no operation was performed; in two enteroplasty was performed successfully, one by Mollard and Bernay and the other by Abbott.

Primary resection was successful in three cases, and secondary resection after a preliminary enterostomy succeeded in another case (Alexis Thomson). Enterostomy failed to save three late cases. Lateral anastomosis was successful in one case. One patient died of peritonitis, although the anastomosis did not leak.

Operation. The late Mr. H. W. Allingham's two cases of enteroplasty were the first to be published.² In each case the stricture was divided in the following way: The bowel having been drawn out, shut off with sponges, and clamps applied above and below, the bowel and stricture were divided longitudinally for three inches on the side of the gut opposite to the mesenteric attachment. Each lip of the longitudinal incision was seized at its centre, pulled apart so that at first it gave the appearance of a diamond-shaped opening, and then, by further pulling in the same direction, the original longitudinal incision was made into one transverse to the long axis of the bowel. The opening was then closed by two continuous sutures (Fig. 322, p. 379).

In any case of stricture of the large intestine, unless there is some very strong evidence in favour of its innocence, it is safer to excise it, for the chances in favour of carcinoma are enormous. In many cases of stricture of the small intestine, enteroplasty, however ideal it may seem, may not be suitable on account of the existence of multiple strictures, or extensive ones. Moreover, active ulceration at the site of the stricture is common, and this may persist and lead to reformation of the stricture. It should also be borne in mind that carcinoma does occasionally occur in the small intestine, and even in comparatively young people. In other cases of acute following upon chronic obstruction, the bowel may be so damaged that enteroplasty is out of the question, and resection or enterostomy has to be adopted.

Sargent draws attention to the risk of spur formation at the mesenteric attachment in performing enteroplasty. In most cases lateral anastomosis undoubtedly offers a better prospect, because it can be made between healthier and more movable parts of the intestine which can be more easily delivered and packed off during the operation. Enteroplasty is a good and simple operation for fibrous, annular, mobile strictures of the small intestine.

¹ *Ann. of Surg.*, 1904, xxxix, 733.

² *Lancet*, 1894, i, 1550.

CHAPTER XVIII

OPERATIONS FOR APPENDICITIS. INFLAMMATION OF MECKEL'S DIVERTICULUM. PERFORATION OF TYPHOID ULCER. DIVERTICULITIS OF THE COLON

OPERATIONS FOR APPENDICITIS

APPENDICITIS is most difficult to classify into different forms, for the varieties and degrees of inflammation of the appendix merge imperceptibly into each other. No one can foretell at the beginning of an attack what course the disease is going to take, for at any moment a simple appendicitis may be complicated by perforation and spreading peritonitis. The experience of a large number of operations at all stages of the disease teaches us that it is impossible to diagnose the exact condition of the appendix and peritoneum before the abdomen is opened. It also teaches us that the condition of the parts does not vary at all accurately with the duration of symptoms, although it is certain that the earlier an operation is undertaken the more likely is the disease to be limited to the appendix and the result of operation to be good. However, it is convenient to attempt a rough classification before discussing the important question of treatment.

(1) *Simple Appendicitis* Here the inflammation is limited to the appendix. There is little or no inflammation of the peritoneal coat and no infection of the peritoneal cavity, although there may be a little serous effusion. Each attack damages the appendix a little more and leaves its lumen more obstructed by contraction or kinking, and often calculi form inside.

(2) *Appendical Colic* Here the appendix is obstructed at intervals by kinking of its wall or, more commonly, by some foreign body within. Attacks of colic lasting from a few minutes to a few hours develop and these may be associated with nausea or vomiting. These attacks are commonly called "bilious attacks". They are rarely accompanied by a rise of temperature, for there is little or no inflammation, but the appendix is tender during the attacks. The pain is not often limited to the right iliac fossa, but is often epigastric or umbilical, probably due to reflex spasmodic contractions of the stomach, or of the ileo cæcal sphincter obstructing the small intestine.

(3) *Chronic Appendicitis* A chronic inflammation of the appendix, without fever or definite acute attack, is quite common and causes chronic indigestion, frequently thought to be due to unsuitable diet. In more severe cases gastric or duodenal ulcer is closely simulated. There may be no pain in the right iliac region, although tenderness is generally noticed there during the "indigestion".

(4) *Appendicitis with a Localised Abscess*

(5) *Appendicitis with Spreading Peritonitis*

Severe inflammation with perforation or gangrene of the appendix may cause either a localised abscess or spreading peritonitis. Usually the pus is localised at first inside or near the appendix, but it either gradually or suddenly invades more and more of the general peritoneal cavity. The sudden onset of a diffuse peritonitis is nearly always due to the rupture of an abscess which, while localised, often gives few signs or symptoms. It is a mistake, unfortunately a common one, to think that a peritoneal abscess once localised always remains so. It is common for an appendical abscess to leak into the pelvis; a retrocæcal abscess often leaks downwards and inwards behind the cæcum; but it often bursts on the outer aspect of the cæcum and travels obliquely downwards and inwards over its external aspect—the line of travel being plainly visible as a greyish-yellow streak. For a time the pus may be localised in the pelvis by the pressure of gas in the small intestine, rarely by frail adhesions, but as it increases in bulk it ascends into the left iliac region and later into the left loin and amongst the coils of the small intestine. It is common to find at an operation: (a) a slack abscess of some days' or a week's duration about the appendix, containing thick yellow or brown offensive pus; (b) a yellow streak leading from this to a collection of sero-pus in the pelvis; (c) a free serous sterile and bactericidal effusion in the general peritoneum.

In later cases there may be sero-pus in the lower half or two-thirds of the abdomen. In a few neglected cases the pus is everywhere, even between the liver and the diaphragm.

A high appendical abscess often travels upwards to the right kidney pouch below the liver and occasionally between the liver and diaphragm. A retrocolic abscess sometimes causes cellulitis of the retroperitoneal tissues of the loin, which may extend upwards as far as the pancreas and duodenum, or inwards to the iliac vessels.

Appendicitis usually recurs, for each attack leaves the appendix more damaged and more liable to obstruction. Very severe attacks, especially those associated with prolonged suppuration, may occasionally destroy the appendix or lead to the discharge of a calculus so that recurrence is not so common after grave attacks of suppuration. It is, however, an error to think that suppuration is a safeguard against recurrence, for the only safeguard is the actual removal or destruction of the appendix—a matter not wisely left to nature, for the latter is clumsy, dangerous and uncertain in its attempts at radical treatment.

WHEN IS IT WISE TO OPERATE FOR APPENDICITIS?

A. Early in the Attack. In 1925,¹ 2,862 deaths in England and Wales were certified to be due to appendicitis, an increase of 326 since 1913. In the United States of America² over 11,000 deaths from appendicitis were recorded in 1920. A great many more are due to the numerous complications and sequelæ of this dread disease, without the primary cause being recognised. This waste of life is all the more lamentable because the victims of the disease are mostly young people whose life work has hardly begun, over 50 per cent. being under twenty years of age, and because timely operations would save

¹ Registrar-General's Report.

² W. D. Gatch and D. C. Durman, *Annals of Surgery*, 1924, lxxix, 862.

the great majority. How can this tragic waste be prevented? Chiefly by the better education of all concerned, resulting in earlier diagnosis and better treatment. Many lives can be saved by the earlier recognition of minor attacks—too often called “bilious attacks,” which so often precede the graver ones. These should be regarded as warnings of greater trouble to come. Appendicitis is by far the commonest cause of abdominal pain, with “bilious attacks” or “indigestion,” especially in young people, the appendix is usually tender in these attacks and, if so, it ought to be removed at a small risk before a serious attack of acute appendicitis develops. Delay is the one great cause of death, and for this ignorance and apathy are chiefly responsible. The public, and especially those in charge of children, should be taught that severe abdominal pain is a serious symptom demanding the immediate attention of a medical man and not the administration of a purgative.

When he sees such a case, the doctor must do everything possible to arrive at an early diagnosis, and meanwhile put the patient to bed, allow nothing to be given by the mouth, and forbid all purgatives. For intestinal peristalsis tends to increase and spread the inflammation. If he suspects acute appendicitis he has the grave responsibility of deciding without delay if an operation is necessary. An immediate consultation with a surgeon is indicated in all suspicious cases.

Osler, in his standard work, *The Principles and Practice of Medicine*,¹ writes

“Gradually the profession has learned to recognise that appendicitis is a surgical disease. In hospital practice the cases should be admitted directly to the surgical wards. Many lives are lost by temporising. The general practitioner does well to remember—whether his leanings be toward the conservative or the radical methods of treatment—that the surgeon is often called too late, never too early. There is no medicinal treatment of appendicitis. There are medicines which will allay the pain, but there are none capable in any way of controlling the course of the disease. Operation is indicated in all cases of acute inflammatory trouble in the cæcal region, whether tumour is present or not, when the general symptoms are severe, and when at the end of twelve hours, or even earlier, the features of the case point to a progressive lesion. The mortality from early operation under these circumstances is very slight.”

Personally I firmly believe it is wise to get a good surgeon to operate whenever practicable in every early case *as soon as the diagnosis of appendicitis is made or strongly suspected, and the sooner the better, if possible within twelve hours.*

This is by far the best way to avoid dangerous and troublesome complications, and it is to be remembered that appendicitis is dangerous only when the infection is allowed to spread beyond the appendix and to give rise to serious complications, which must take some time to develop and are therefore preventable.

Early operation saves the patient a great deal of pain, misery, time and money and relieves the medical attendant of much anxiety. That it saves time and money is clear, for if the patient gets over the attack he will have to lie up again during the operation deferred until the interval, in this way the time of disablement and the expense are usually more than

¹ 8th Edition, 1920 p. 537

doubled. If suppuration develops, and an operation becomes absolutely necessary late in the attack in spite of conservative treatment, the patient may be laid up for weeks or even months. On the other hand, early operation abolishes the need of drainage and avoids the risk of hernia or subsequent intestinal obstruction. In the early stage, especially in the first attack, the operation is nearly always easy, because adhesions are few or soft, and it is nearly, if not quite, as safe as an "interval" operation; but no one can foretell the end of any attack of appendicitis under conservative treatment. No disease is more treacherous, for what may appear to be a mild attack frequently ends in perforative peritonitis or death. No one can say what is going on in the appendix or peritoneum until the abdomen is opened, for it is common upon exploration for slight symptoms to find a tense gangrenous appendix. The lull that often follows perforation is particularly deceptive, free pus being found sometimes in a supple abdomen, especially in children, or in women during pregnancy or soon after labour.

Nothing but early operation can remove the cause or set a limit to the spread of infection.

Various authorities give the mortality of appendicitis under modern medical or expectant treatment as from 8 to 12 per cent. At the London Hospital¹ the mortality of 341 late cases treated by medical treatment and delayed operation was 3·5 per cent., but this can be reduced below 0·5 per cent. by operating at the earliest possible moment. I have not lost a single patient operated upon within twenty-four hours; and, as shown by Dr. Mutch,² there were no deaths from the operations of many surgeons within the same interval at Guy's Hospital during the four years 1906-1909. At the London Hospital³ during the years 1920-1923 inclusive there were 221 operations within twenty-four hours of the onset of symptoms with a mortality of only 0·9 per cent. There is no need to labour this point, for the experience of surgeons all over the world has conclusively proved that the mortality of early operations for acute appendicitis is very low.

In a good many cases, perforation of a pyloric or duodenal ulcer, inflammation of Meckel's Diverticulum, suppuration of the gall-bladder, intestinal obstruction and ruptured tubal foetation have been mistaken for appendicitis, and the resulting delay in treatment under the conservative regime has usually been serious. Early exploration enables the surgeon to discover his error and to treat these grave conditions while they are in a hopeful stage. Although a mistake in diagnosis is occasionally made, the abdomen is rarely opened for a supposed appendicitis without revealing some other acute disease calling for immediate surgical treatment. A blank laparotomy is better than overlooking appendicitis. since is particularly important to remember the possibility of mistaking from app.coli infections, especially of the right kidney, for appendicitis. due to the maff pregnancy is also important to bear in mind. without the primaf surgeon is not available it is better to adopt the Oschner⁴ all the more lamentable and to keep the patient at absolute rest on rectal young people whose life workmouth until the symptoms are abating. Above under twenty years of age, and *Brit. Journ. Surg.*, 1924, xii, 232.

¹ 1910, xlix, 107.

¹ Registrar-General's Report.

² W. D. Gatch and D. C. Durman, *Ann.*

all, neither sedatives nor purgatives should be given. An operation must be undertaken if signs of localised abscess or peritonitis develop.

The following symptoms and signs strongly suggest acute appendicitis.

Acute pain in the middle of the abdomen sometimes well above or even to the left of the navel, perhaps settling in the right iliac region, superficial and deep tenderness and rigidity in the latter situation or, failing this, lower toward the pelvis or higher toward the loin where the appendix may lie. The thighs must be flexed and the body supine and at rest while this most important sign is sought. Sometimes the pain and tenderness may be pelvic. Occasionally the appendix or abscess may be feelable either in the right iliac fossa or in the pelvis from the rectum or vagina. There are anorexia, nausea, and often vomiting in the early or severe stages. The temperature is nearly always raised, the face is frequently flushed, the tongue furred and white, and the pulse is quickened, often bounding. The pain is often so intense as to prevent sleep. The bowels are usually constipated, but there may be early diarrhoea especially if the appendix is in the pelvis. Frequent and painful micturition also indicate a pelvic appendix. All these symptoms and signs may abate when the appendix perforates and tension is relieved. This lull in the storm deceives the unwary, but it is often followed in a few hours by signs of spreading peritonitis. Leucocytosis is usually present, and is of considerable value in the diagnosis of doubtful cases, especially when a localised deep abscess has developed in an obscure situation such as high up and far back in front of the sacrum or behind the ascending colon.

Serious Complications which can be avoided by early Operation.

Spreading Peritonitis. Frequently during an early operation a gangrenous distended, but still shiny appendix is discovered ready to perforate at any moment. No one can say with any pretence of accuracy, what the condition of the appendix may be until the abdomen is opened, and to wait is bound to be disastrous in many cases. Although the appendix may perforate within twenty four hours or less it is rare to find diffuse peritonitis at that time. A local collection of sero pus near the appendix or in the pelvis is infinitely more common. At first the pus is not limited by any adhesions, but only by gravity and the elastic pressure of the flatulent intestines, especially the cæcum. The effusion increases more or less rapidly according to the virulence of the infection and the reaction of the peritoneum. Unlike the stomach, the appendix is too small to flood the peritoneum, therefore appendicular peritonitis is commonly of the spreading or creeping type. Usually the extravasation from the perforated appendix is found in the right iliac fossa, often behind the cæcum. As the effusion increases it overflows into the pelvis, especially if the patient walks about. When the pelvis is full unless limiting adhesions have formed, the fluid rises to the left iliac fossa, left loin and amongst the coils of small intestine. In very late cases the peritonitis may be general, pus being discovered above the spleen and liver. At any stage limiting adhesions may isolate a localised abscess, but with increasing tension this may burst and flood a large part of the peritoneum. Our aim should always be to operate before the appendix perforates and thus to avoid either localised or spreading infection of the peritoneum. When the peritoneum has become infected the sooner an operation is performed

the better, for the early removal of the source of infection and the extravasation nearly always arrests the spread of the disease.

Localised Abscess. It is much better to operate before an abscess can have time to develop. I am well aware that this is not always possible because patients often do not send for their doctor until an abscess has already formed. There are instances of subacute attacks in which patients continue to work until an abscess or peritonitis develops. The dangers of an appendical abscess are chiefly due to its liability to rupture into the peritoneum, causing spreading peritonitis. Many of the cases of peritonitis are of this grave secondary type. During the operation for appendical abscess it is often noticed how frail are the adhesions that separate the abscess from the abdominal cavity, so that any unusual exertion, an enema or the natural increase of tension may lead to rupture into the peritoneal cavity at any moment. In more fortunate cases the abscess may burst into the intestine, and the patient may get well soon after this; but it is a mistake to think that such a patient is not liable to future attacks. An abscess may burst into the urinary organs, possibly leading to cystitis and ascending suppurative nephritis. An abscess may form in the pelvis and lead to permanent damage to the important structures placed there. Residual abscesses may form at some distance, such as subdiaphragmatic abscess, which is still attended by a high mortality.

Empyema and other Pulmonary Complications. There is little room for doubt that infections of the lungs and pleura are mostly embolic, and that the liability to them increases with the duration of the appendicitis. It is a fact that these complications, and especially subdiaphragmatic abscess, are far less common in patients treated by early operation. It stands to reason that, with the continued presence in the abdomen of an inflamed appendix with infected blood-vessels in communication with the portal vein, portal pyæmia is much more likely to occur than if the appendix is removed at once. Moreover, a suppurating appendix is a constant source of general blood-poisoning.

Intestinal Complications. Intestinal adhesions with secondary intestinal obstructions and also fæcal fistulæ are far more likely to develop in neglected cases. Moreover there is some evidence to show that chronic constipation in many cases dates from a severe attack of appendicitis, followed by contracting adhesions.

Hernia. By operating very early the risk of hernia is greatly reduced, for the abdomen can be completely closed in the majority of cases without endangering the life of the patient. In this respect, these early cases are in striking contrast with those for which an operation has to be performed later for spreading peritonitis or large abscess, when it is necessary to drain the abdomen for a few days at least.

B. Late and Suppurative Cases. It must be allowed that although an operation at the earliest possible moment, within twenty-four hours, is the safest and best treatment for appendicitis, it is often impossible to get this done for various reasons. Poor patients often do not ask their doctor to see them until they are getting seriously ill and have tried in vain all their homely remedies, more especially a variety of purgatives. A competent surgeon may not be available, the diagnosis may seem doubtful or a patient may at first refuse operation. But if the advantages of early

operation were properly appreciated by the public and by the rank and file of the medical profession it is certain that there would be less delay.

In late cases, after thirty six or forty eight hours, it is best in a few selected cases to try conservative treatment, in a hospital or nursing-home near the surgeon, and to keep an hourly record of the pulse and temperature. The patient is placed in the Fowler position and given nothing but water by the mouth. If the attack subsides—as it does in about two thirds of such cases—the appendix can be removed when all signs and symptoms have disappeared. If, on the other hand, the pulse and temperature do not subside and the local condition gets worse or a localised abscess forms, an operation is undertaken without delay.

Love¹ found the mortality of these deferred operations to be about 6.5 per cent, which compares very favourably with that of operations carried out on the third or fourth day, which is over 10 per cent.

J. B. Deaver and J. A. H. Magoun,² in a review of 5,488 appendicectomies at the Lankenau Hospital, found that the mortality was reduced to 4.2 per cent in the years 1915-1919, due to the adoption of the expectant treatment for selected cases first seen after thirty six hours. When all cases were operated upon at once, between the years 1901-1905, the mortality was 10.5 per cent. In my wards at Guy's Hospital it has been the rule to operate upon all cases of acute appendicitis as soon as possible after admission and not to refuse or defer operation because of the lateness of the disease or the grave condition of the patient. In such cases measures are taken to resuscitate the patient (such as saline glucose infusions), and the operation is carried out without further delay. Mr. B. L. Laver, then my Surgical Registrar, found that between 1919 and 1925 there were, in my wards, 408 operations for acute appendicitis with 18 deaths a mortality of 4.4 per cent. At autopsy, 10 had general peritonitis, three pneumonia, two pulmonary embolism, and one empyema. The mortality of the 16 cases coming in with diffuse peritonitis was 25 per cent, whereas it was only 0.4 per cent in the 223 cases where the disease was limited to the appendix, and 2.9 per cent in 36 cases of abscess. There were no deaths in the 36 cases of localised peritonitis.

Most of these cases came in very late and from a poor district. Many of the operations were performed by my junior colleague, Mr. L. Bromley, or under his supervision.

It is most important to remember that no hard and fast rule can be wisely given for these late cases. Much depends on the study of all the facts and circumstances of each individual case. Temporising is notoriously unsafe with children, old people and women after labour, when resistance to infection is much below the normal. When circumstances are unfavourable for constant observation and complete control, when the patient is stranded in the country or when an operation cannot be performed if required at short notice, it is often safer for an expert surgeon to operate when he first sees the patient, for such a favourable opportunity may not occur again. Much depends on the individual surgeon, for one who is experienced and expert can complete the operation in a few minutes with the minimum of disturbance of the intestines and peritoneum and the

¹ *Brit Journ Surg*, 1924, xii, 232.

² *Ann of Surg*, 1924, lxxix, 834.

least amount of anæsthetic. Under these circumstances the risks of spreading the infection and lowering the resistance of the patient are more than compensated by the benefits accruing from the removal of the source and products of infection.

It is important to mention some of the most reliable signs and symptoms which indicate that the patient is getting worse, and that an operation is urgently required to save life.

Signs and Symptoms. (1) Increasing rigidity, tenderness and fixation of the abdominal wall. When these signs are localised to the right iliac fossa, they usually indicate a localised inflammation, but when they are not localised they indicate a spreading peritonitis.

(2) Persistence of pain and vomiting.

(3) Accelerating pulse-rate.

(4) Rapidly rising or falling temperature, especially associated with shivering.

These indicate a rapid spread of the disease and often follow the discharge of pus into the peritoneal cavity.

(5) The presence of a tender, dull swelling in the iliac fossa, loin or pelvis, the latter being discovered by bimanual examination.

(6) Leucocytosis, especially a rise in the proportion of polymorphonuclear cells. This is most marked when a localised abscess has formed.

These indicate localised abscess. When the abscess is unusually high, the appendix is retro-cæcal or the cæcum has failed to descend naturally; when it is situated in the pelvis the appendix is hanging over the brim. A pelvic abscess is often indicated by frequent and painful micturition, rectal tenesmus and diarrhoea. It may not be possible to feel the localised swelling until the abdominal muscles are relaxed by an anæsthetic. The swelling may be resonant, especially in late cases, from the presence of gas in the abscess. It is foolish to wait for fluctuation, redness or œdema before opening a localised abscess, because of the grave danger of peritoneal spread and vascular infection.

(7) Rapid wasting.

(8) Profuse sweating, often associated with rigors.

These indicate spreading infection and suppuration.

The peritonitis is getting grave when distension of the abdomen and tympanites develop; but operation should not be deferred so long. Sometimes patients are seen in a state of collapse and too ill for any operation. It is then wise to endeavour to revive them by warmth, continuous rectal or axillary infusion and the injection of pituitary extract before undertaking an operation.

C. In the Quiescent Period, after one Attack. Most authorities now agree that it is wise to remove the appendix after one definite attack of appendicitis unless there is some grave contra-indication to any operation. One attack, unfortunately, does not protect against another; on the contrary, it is a matter of common experience that it predisposes. There are no available data to show in what proportion recurrence may be expected. The necessary statistics could only be obtained by tracing the life histories of a large number of patients not submitted to operation. It used to be thought that suppuration destroyed the appendix and thus prevented recurrence, but statistics brought before the Medico-Chirurgical

Society in 1905 clearly prove recurrence to have occurred in over 15 per cent of the collected cases of drained abscesses although most of the patients could not have been traced for more than a few years. Recurrence is certainly more frequent after simple appendicitis without suppuration.

In any case there is no means of telling beforehand which are the lucky patients who will escape recurrence for a perfectly healthy interval is characteristic of this disease. In fact the patient feels and looks so well that he and his relations can scarcely believe him to be in danger and for this reason in spite of advice an operation is too often deferred. The patient prefers to take his chance and only submits to operation during or after a recurrence.

Further, the nature of a second or subsequent attack is not certain but the histories of a large number of cases tend to show that successive attacks usually increase in severity and this is what is to be expected from the mechanical changes taking place in the appendix and its mesentery during and after each attack of inflammation. Early attacks are sometimes so trivial as to be forgotten or to be only remembered as 'bilious attacks', gastritis or indigestion for there may be no pain in the right iliac fossa in mild attacks when the peritoneum is not inflamed. Sometimes however the very first attack is a grave one leading to spreading peritonitis. It is a common mistake to suppose that a severe attack greatly reduces the risk of peritonitis in the future but adhesions rarely shut off the whole appendix from the peritoneal cavity they often vanish altogether so that the appendix may be found lying free in the abdominal cavity a month after a severe attack associated with a large swelling.

The risk of an operation undertaken by a good surgeon in the quiescent period is very small numerous statistics showing it to be under 0.5 per cent the risk of death from a single recurrence is far greater than this even if it be allowed that a certain proportion up to 50 per cent may never develop another attack. Without operation the mortality of appendicitis has been shown by physicians to be about 10 per cent.

The medical experts of insurance companies recognise the financial risk of insuring these patients before they have had the appendix removed.¹

A careful examination would be made to elicit any tenderness swelling or hardness about the region of the cæcum which would require the case to be postponed for reconsideration at a later date after the appendix has been removed. In any case supposing there had been with in the past five years a definite attack of appendicitis and *a fortiori* a second attack however complete the recovery may have been an extra five or seven years according to the age would be necessary to cover the risk of relapse and operation.

In cases in which the appendix had been successfully removed and a healthy scar alone remained the life would be accepted without addition.

For many reasons it seems foolish to wait for a second attack before operating. It is far better to get rid of the appendix and to be on the safe side. To wait for a second attack with the idea of operating very early in it seems to me to be wrong because no one can foretell the circumstances under which the second attack may arise. It may be impossible to operate early enough to make the operation as safe as one undertaken in the quiescent period. The best time for operation is about ten days

¹ See Richard Douglas Powell On the Medical Aspects of Life Insurance *Practitioner* April 1912 p. 396

after an attack, when the inflammatory exudations have absorbed and the temperature has been normal for a week. While waiting for operation the patient should avoid all but the gentlest exercise. An operation undertaken within a few days of a bad attack may be attended with considerable difficulty on account of vascular adhesions and possible pockets of pus, so that drainage has to be established in some cases, with the attendant risk of hernia.

Some attacks never do subside but become sub-acute. There are usually slight fever, wasting and anæmia with some local induration due to the presence of a small abscess with thick walls. There is nothing to gain by waiting in these cases and much to lose from the risk of complications.

D. For Appendical Colic. There are many patients who have never been laid up with a definite attack of appendicitis, but who frequently suffer from colic lasting, as a rule, from a few minutes to an hour or more. The pain, which is not so severe as renal, biliary or lead colic, is associated with nausea, sometimes with vomiting and pallor. The pain is often brought on by exercise and by food. It compels the patient to rest for a few minutes, but it soon passes off and leaves him quite well. The pulse and temperature are rarely changed, although the latter may rise to 99 or 100 soon after the attack. The pain is at first referred to the middle of the abdomen and sometimes to the cæcal region. During the attack and generally after it there is a distinct local tenderness and sometimes a pencil-like swelling in the region of the appendix.

In many of these cases the pain interferes with the enjoyment of food and exercise. Upon exploring the abdomen, the appendix is the only abnormal thing found. It is rarely adherent but is kinked or obstructed. After removal small hard fæcal masses or concretions, sometimes with nuclei of caraway seeds (as in two of my cases) or shot, and occasionally a large number of thread-worms, are found in the appendix. The attacks cease when the appendix is removed.

Care is required in the diagnosis and especial care must be taken firstly to exclude constipation, right renal and ureteral calculus and intermittent hydronephrosis; and secondly to explore the abdomen thoroughly at the operation. Under these circumstances the removal of the appendix is strongly indicated in order to prevent graver attacks and chronic invalidism.

Example. A boy, aged 10, a patient of Dr. Bryden, of Godalming, was a thin, pale boy, who had never been very strong. Four years ago he had sunstroke and his temperature was 105°. Since then he has frequently had attacks of abdominal pain often lasting only a few minutes. While in the middle of a game he would often shout out and say, "I have got that pain again," and have to stop. He was said to suffer a good deal from indigestion. He saw a physician, who dieted him. He was sent away several times for long periods with the idea of improving his general health. The abdominal pain still persisted. It was never associated with diarrhœa, but the boy was always rather troubled with constipation. About six weeks ago Dr. Bryden saw the patient during an attack of pain, and he then noticed that the pain, which had usually been situated above the umbilicus, was more marked in the right iliac region and that there was a distinct tenderness in this neighbourhood. The patient was kept in bed for two or three days and then was quite well again. There was no elevation of temperature in the attack, which lasted about two days. Dr. Bryden diagnosed appendicitis and sent the patient to see Dr. Newton Pitt, who agreed and advised operation. The attacks of pain were sometimes associated with nausea or vomiting.

Operation There were many enlarged glands in the lower part of the mesentery, but none of them were very large and no caseous foci could be discovered. There were no signs of tuberculous peritonitis. The appendix and cæcum were brought out into the wound. The former was unusually long and twisted upon itself at two points. Its kinking was maintained by means of fairly old peritoneal adhesions. Towards its distal end the tube was rather bulbous and of a dark colour. Its mesentery was tied with catgut and divided. The root was crushed divided and inverted into the cæcum in the usual way. The appendix contained four small softish calculi near its tip which was dilated. The condition was such as often causes appendical colic.

The boy had no more attacks of pain and his general health improved to a remarkable degree.

E Chronic Appendicitis, Appendix Dyspepsia This may be primary but in most cases it dates from acute appendicitis years earlier. These patients suffer from indigestion or dyspepsia associated with anorexia, pain after food, tenderness over the appendix, flatulence, nausea, sometimes vomiting after food, and even hæmatemesis. These symptoms may be continuous and even severe, but they more commonly last from a few days to a few weeks and recur from time to time. As Moynihan has pointed out the symptoms may closely simulate those of chronic gastric or duodenal disease and the condition is frequently discovered after a negative exploration for these or gall bladder disease. It is necessary to do everything possible to establish the diagnosis of chronic appendicitis before advising operation and to make sure by careful exploration, that the appendix is the cause of symptoms. Too many appendices have been removed for supposed chronic appendicitis without sufficient evidence and naturally with poor results which brings surgery into discredit and leads to delay in consenting to operation when there is real and urgent need of it.

Chronic appendicitis is often due to obstruction by bands, adhesions, stricture, kinks, volvulus or calculus of the appendix. Sometimes it is found to be subacutely inflamed, congested or oedematous in typical appendix dyspepsia as described by Ewald its tip is contracted, hard and fibrous, its middle congested inside, and its base normal. When the operation is performed in a quiet period the appendix may appear to be almost normal.

It is remarkable how little change may be found in the appendix in the intervals between attacks of acute appendicitis. Slight obstructions, adhesions or faecoliths are capable of creating a great deal of misery and 'indigestion'. It needs the microscope to reveal the full extent of chronic disease in some cases.

The diagnosis of 'indigestion' is getting less and less common, for accurate study and observation of symptoms and signs and thorough abdominal exploration so often proves 'indigestion' to be due to some definite disease, especially of the gall bladder, appendix, duodenum or stomach.

The most important point I wish to emphasise is that although an accurate diagnosis can be made in a great many cases before the abdomen is opened, absolute certainty can be attained only by a thorough exploration of the abdomen. Therefore, *abdominal operations should practically always start as explorations*. Fortunately the peritoneum allows this to be done in a few minutes, and without additional risk in the great majority of cases. A notable exception is to be found in peritonitis due to

appendicitis, more or less localised to the lower abdomen, where it is neither necessary nor wise to examine the upper abdomen.

Moynihan has drawn special attention to the importance of seeking a diseased appendix when an exploration for gastric disease proves negative. The cases quoted below show the great importance of bearing this always in mind. It is just as important to examine the upper abdomen when operating in the quiet period for supposed appendicitis, for it is not at all uncommon to find the disease in the gall-bladder or duodenum.

I have operated on many patients for duodenal ulcer whose symptoms had remained unrelieved by the removal of the appendix elsewhere through an incision too small for adequate exploration of the abdomen. The possibility of this error is sufficient to condemn the practice of removing the appendix through a very small incision.

Further, in many cases, disease of several of the abdominal viscera may co-exist and even be dependent on each other; for instance, the appendix is frequently diseased in cases of gastric or duodenal ulcer; it may even be the primary source of sepsis. We know that chronic appendicitis profoundly alters the motor and secretory functions of the stomach and intestines and lowers the general vitality by interfering with feeding and digestion.

Again, it is not uncommon to find disease of the appendix and gall-bladder co-existing. The common association of disease of the right ovary with appendicitis is too well known to need further mention. In these cases inadequate exploration fails to reveal the whole disease and, perhaps, even the most important part of it. The operation is naturally followed by incomplete relief and perhaps by a secondary operation.

Most of the failures of gastro-enterostomy and appendicectomy are due to errors of diagnosis from inadequate exploration.

CASE 1. Chronic appendicitis simulating gastric ulcer. Female, aged 30. has had indigestion since she was 14, and on four occasions she has had hæmatemesis. She has been laid up on many occasions for about six or seven weeks at a time and has been treated at two country hospitals for months, being dieted and even treated by rectal feeding. She frequently vomited after taking any solid food. The diagnosis has always been "gastric ulcer." As she was getting worse, she was sent to me at Guy's for operation upon the stomach in April, 1912. Examination with the X-rays negatived obstruction at the pylorus, but the stomach was low and rather dilated. There was tenderness over the epigastrium and also over the right iliac fossa.

The abdomen was opened, through the middle of the right rectus. The stomach, intestines, pancreas, pelvic viscera and biliary apparatus were all normal except for a slight dilatation and dropping of the stomach, and an appendix which contained a calculus and was in a state of chronic inflammation with shortening of its mesentery. After the operation the patient made a complete and permanent recovery.

CASE 2. Appendix dyspepsia simulating gall-bladder disease. Woman, aged 45. The patient has suffered a good deal from pain in the abdomen, difficulty in taking food, and much wasting. She has also had a lump in the right side of the abdomen near the liver, which was tender, and it was thought that she had enlargement of the gall-bladder, probably due to stones, with possibly growth of the gall-bladder. I was asked to explore, but the prospect did not seem hopeful.

Operation on April 14, 1912, at a cottage hospital. When the patient was under the anæsthetic, the swelling in the right hypochondrium was found to be very movable. It could be pushed into the left iliac fossa and also into the left lumbar region. It was firm and oval and was thought to be the right kidney. The urine and the act of micturition were normal. On opening the abdomen through the right

rectus the swelling proved to be the right kidney, freely movable, not enlarged and not having a me entery. The left kidney was also unaltered and movable. The stomach and duodenum were unusually low and movable and the duodenum could easily be brought out into the wound in its first and second parts. There was no sign of an ulcer in the duodenum or stomach and there was no pyloric obstruction. The pelvic viscera were normal except that the uterus was rather large. The appendix was lying in Morison's pouch close to the liver. It was very long and coiled. There was a narrowing near the end of it with an enlargement beyond. The mesentery was drawn over the tip. The appendix was therefore removed. On cutting into the appendix afterwards it was found to contain pus in two places (1) at the tip and (2) at its middle. There were also very small calculi in these situations. The patient made a rapid and excellent recovery. She was soon able to take full diet.

A OPERATION IN THE QUIESCENT PERIOD

On this subject the profession owes its lead to the late Sir Frederick Treves, who first proposed the removal of the appendix during a quiescent

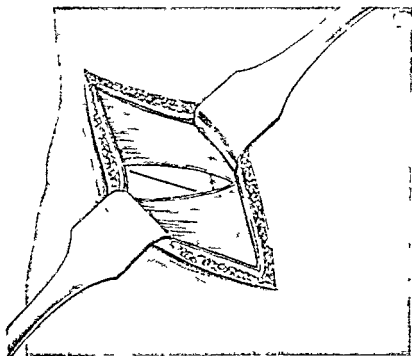


FIG. 223 Usual incision for appendicectomy. The rectus sheath is opened as a rule and the rectus muscle is drawn inwards to give ample room.

period in 1877 in a paper read before the Medico-Chirurgical Society. Although the operation is usually easy, it is sometimes difficult owing to adhesions, especially when the appendix is behind the ascending colon or in the pelvis. An oblique incision is made about four inches long and crossing the line joining the right anterior spine to the umbilicus below its lowest point of trisection. The fibres of the external oblique are separated (see Fig. 223). The internal oblique and transversalis muscles, which run in a direction almost at right angles to that of the skin incision, are now likewise split in the direction of their fibres and well retracted. By making the abdominal incision in this way, a

described by McBurney,¹ the weakening of the abdominal wall which necessarily results from free transverse division of muscular fibres and nerves is avoided. Although the amount of room obtained to work in by this method is somewhat lessened, especially in young children, and the difficulty of the operation to some extent increased, the advantage gained is so distinct that it should be adopted wherever possible, *and much more room can be obtained by opening the rectus sheath and retracting the muscle.* The author always does this and finds it much easier to incise

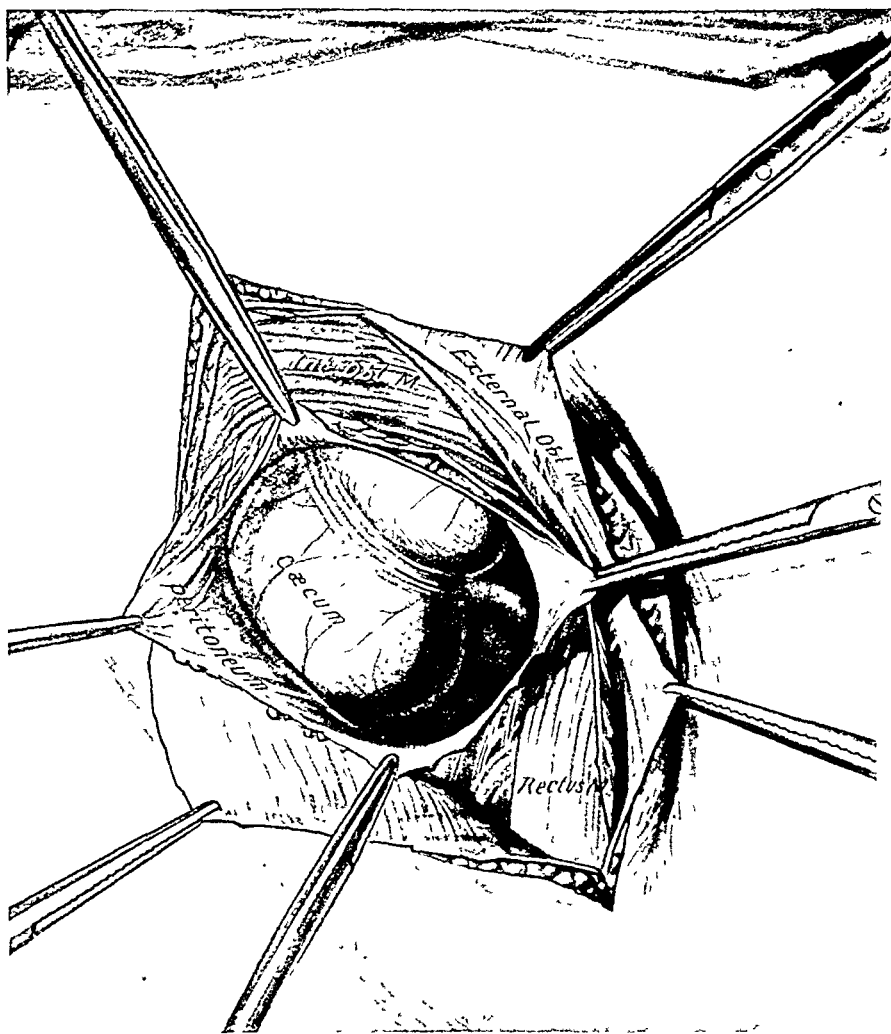


FIG. 224. Muscle-splitting incision extended downwards through the front wall of the rectus sheath. The deep epigastric vessels are exposed near the lower angle of the wound.

the sheath at its outer border first, and to extend the incision inwards and outwards. It is easier to separate the fibres of the deep muscles neatly in this way, for the two are joined together, thin and tendinous at the outer border of the rectus. If still more room is required, the sheath

¹ *Ann. of Surg.*, xx, 38.

may be incised vertically upwards or downwards as required. With self retaining retractors inserted a great deal of room can then be obtained. The peritoneum is picked up with toothed dissecting forceps at the inner part of the wound where there are not likely to be adhesions carefully incised with blunt pointed scissors and enlarged until two fingers can be admitted. In the female the pelvic viscera are always palpated on account of the difficulty of diagnosis in them and of the chance of missing coexisting disease. It is common to find cystic disease of the right ovary when the appendix has been repeatedly or severely inflamed.

In doubtful cases the hand is passed upwards to feel the gall bladder stomach and duodenum. The fingers are then passed downwards and outwards to the right iliac fossa to seek the cæcum. If possible this is brought into the wound recognised by its longitudinal bands and peculiar blue



FIG. 995. Appendicectomy. The ligature is passed at the angle between the appendix and the cæcum so that all the vessels of the former are secured. One strong artery forceps is on the base of the appendix and a second in close contact with the first. The appendix is divided between these with the knife which is not used again.

colour and delivered at once. Sometimes it is necessary to tie off or to separate adherent omentum. When the cæcum is adherent the wound is enlarged and dilated and the adhesions carefully separated by gauze dissection. If there be any suspicion of an abscess gauze packs are carefully placed before the adhesions are separated. The appendix is quite easy to find in the large majority of cases but occasionally it may be difficult to find for it may be embedded in dense adhesions behind the cæcum and ascending colon or in the pelvis. Sometimes the cæcum is misplaced in the right hypochondrium and very rarely it lies in the left iliac fossa with or without transposition of the colon. The end of the ileum and the anterior longitudinal bands of the cæcum are valuable guides to the root of the appendix. When the cæcum has been brought into the wound the end of a gauze roll is placed behind it in the iliac fossa and loin to collect any blood or other material that may drip into the abdomen during the separation of the appendix. The margins of the wound are protected with enveloping pads. If the adhesions are very dense or involving important

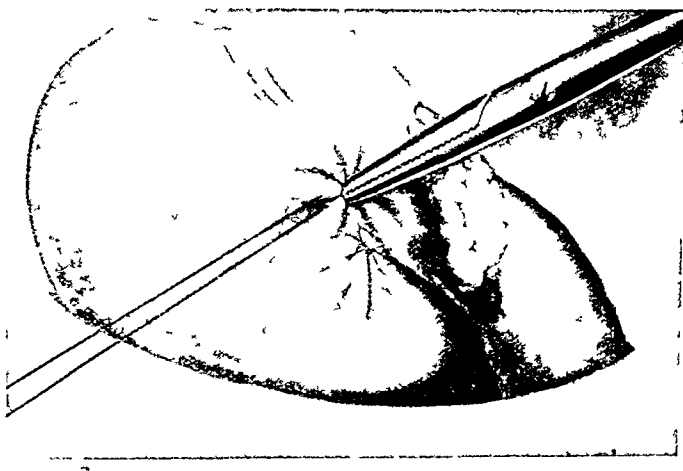


FIG 226 Appendicectomy. The purse-string suture of fine linen thread is inserted before the appendix is removed, but after the mesentery is tied and divided. The basal forceps serve to invaginate the crushed and tied stump. These forceps are not used again.

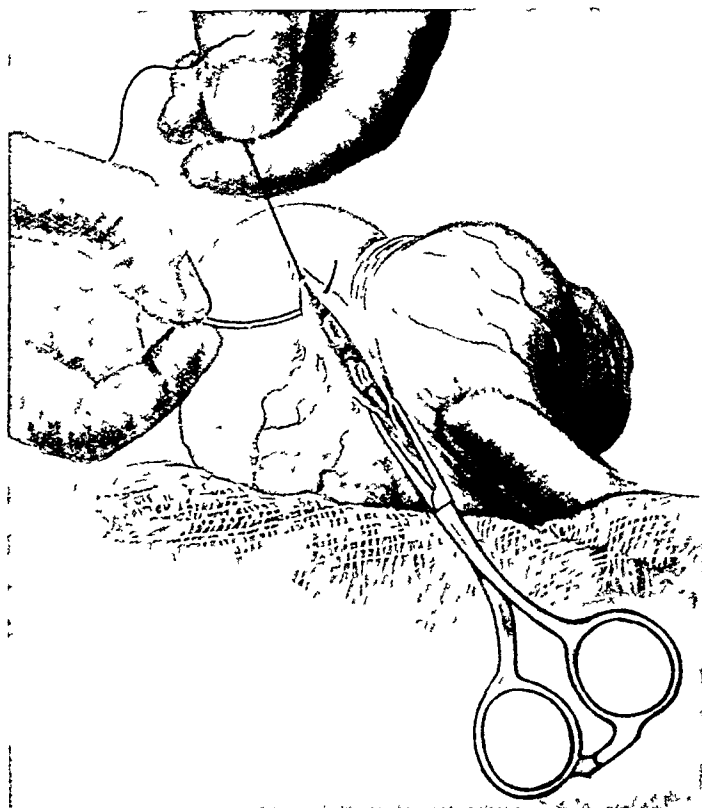


FIG 227 Another method of invaginating the stumps of the appendix and its mesentery

structures such as the intestine, ureter or the vessels it is wise to proceed very slowly and to separate the adhesions by wiping with moist gauze. *It is safest to keep very close to the appendix and in difficult cases to incise its peritoneal coats and to shell its mucous membrane out of its coverings.* This saves time, anxiety, danger and bleeding. When the cæcum and appendix have been delivered and packed off the appendix is removed as follows:

A strong pair of artery forceps pierces the meso appendix in *actual contact with the cæcum and the root of the appendix* and draws two ligatures through this perforation. The forceps are firmly closed on the root of the appendix and another pair is applied in close contact with them on the distal side (see Fig. 278). One ligature is now tied firmly round all the

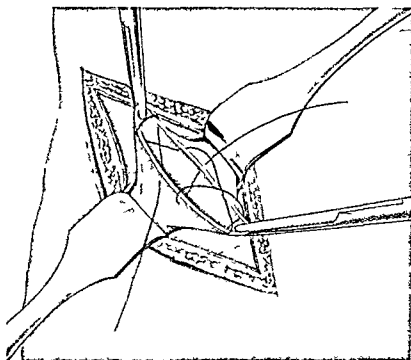


FIG. 278. The peritoneum is brought well forward by two forceps held vertically so that the opening can be easily closed. Only one knot is required.

meso appendix and well away from the appendix as the latter is held up by an assistant with the forceps and fingers. The other ligature is tied round the root of the appendix between the forceps and the cæcum. When passed in this way the ligatures secure all the blood vessels including one that is often close to the root of the appendix. This small artery has been missed and fatal hæmorrhage has occurred from it. The mesentery is divided leaving a good stump beyond the ligature. In some cases the meso appendix is broad and short and has to be ligatured in sections, care being taken to secure all the vessels including the one near the root of the appendix. In others it is easier to tie it after it has been clamped and divided in order to get a deeply placed appendix out of the way. The appendix is severed by running the knife between the two forceps, one of which prevents leakage from the appendix and the other is

used to invaginate the crushed stump into the cæcum, as a sero-muscular purse-string suture is tied. This is inserted in the outer coats of the cæcum a quarter of an inch away from the root of the appendix (*see* Fig. 226). The knife and forceps used for the appendix are laid aside and are not used again during the operation. The packs are removed, the cæcum is returned and the wound is closed in layers with No. 1 catgut. It is easier to sew the peritoneum if the latter is held well up by toothed artery forceps at each end of the incision (*see* Fig. 228). One \times -suture is sufficient for the deep muscles. The external oblique aponeurosis needs a longer continuous suture. The skin and subcutaneous tissues are sewn with a continuous suture (*see* Fig. 229).

Some surgeons prefer Battle's incision for removing the quiescent appendix; displacing the rectus inwards, but it is easier and much better to use the modified grid incision (p. 395), which leaves a sounder wall. When pelvic complications are anticipated a low right paramedian incision is better, for it allows the safer and easier removal of a pelvic tumour, especially one arising in the left ovary or tube. When a general exploration is necessary the middle third of the right rectus is displaced outwards, and the wound is enlarged upwards or downwards if necessary (*see* Fig. 231).

B. OPERATION FOR ACUTE APPENDICITIS

Unless the diagnosis is doubtful or there are indications for a thorough visual exploration of the abdomen the McBurney incision is the best. It is made high or low according to the position of the appendix as

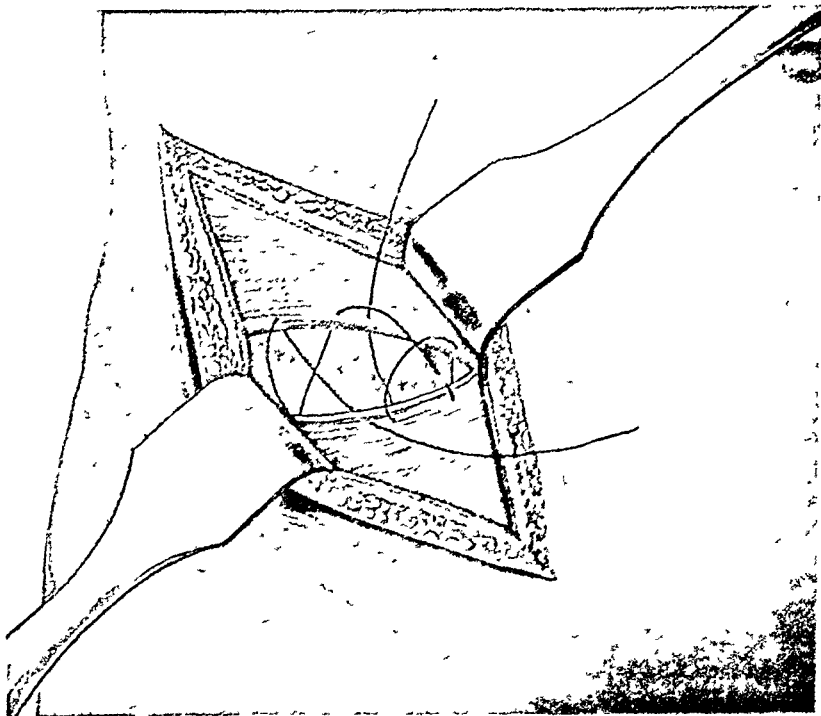


FIG. 229. Appendicectomy. Simple and effective method of bringing the deep muscles together.

indicated by the situation of tenderness, rigidity and swelling, and especially by the site of the swelling, which is often palpable, perhaps for the first time, when the muscles are relaxed by the anæsthetic. When the operation is undertaken as it should be whenever possible, before the appendix has perforated, it does not differ from the operation during the quiescent period. It is usually very easy, especially when it is carried out in the first attack, for there are few if any troublesome adhesions. The edges of the wound are carefully enveloped to prevent infection during the operation.

C OPERATION FOR APPENDICAL ABSCESS

When the operation is later and a considerable swelling can be felt, indicating a *localised abscess* there are two alternatives.

(1) The abscess is merely opened and drained if possible without opening the general peritoneal cavity. This is the safest plan for bad cases.

(2) The general peritoneum is deliberately opened first so that the pelvis can be explored and packs can be placed before the abscess is opened. The pus is mopped away and the appendix is removed.

The relative advantages of these methods are discussed on p. 403.

(1) *The Abscess is merely opened and drained.* With the abscess in the usual situation the McBurney incision is made over the outer aspect of the swelling. As the deep muscles are separated œdema of the tissues is recognised. The peritoneum is incised near the outer end of the incision and pus often escapes at once. If the peritoneal cavity is opened in front of and internal to the abscess gauze packs are carefully placed above internal and below the latter. A gauze roll gently paid in and secured at its outer end is the best. The pus is sought by blunt dissection at the outer part of the wound the cæcum being displaced forwards and inwards as a rule. A forefinger is introduced to seek the appendix or concretion, both of which, if loose, are removed. Care is taken to avoid breaking down adhesions and thus causing a leak of pus into the general peritoneum. The finger also ascertains the size of the abscess and its most dependent point where a counter incision may have to be made for efficient drainage. This is usually in the loin or just above the pubis in the middle line, above the empty bladder, occasionally a pelvic abscess is drained through the vagina.

(2) *The Abscess is opened and the appendix is removed.* When the abscess is in the usual situation the McBurney incision with opening of the rectus sheath and retraction of the muscles usually affords enough room. When the abscess is far out, and especially when it extends to the loin indicating a retro-cæcal appendix Davis' ¹ transverse incision is valuable. This is usually made on a level with the anterior superior spine, but it may be placed higher or lower as required. The fibres of the external oblique aponeurosis are cut across but those of the deep muscles are merely separated as usual. The rectus sheath is opened and the muscle drawn inwards. In difficult cases the wound is prolonged outwards as far as the anterior spine and inwards almost to the linea alba thus giving plenty of room and a good approach to the retro-cæcal appendix. Another advantage of this incision is that it allows drainage to be established at the outer angle of

¹ *Ann. of Surg.*, 1906, XLII, 106. A. E. Rockey also advocated this incision (*Ann. of Surg.*, 1924, LXIV, 740).

the wound close to the ileum, where a hernia is not likely to develop. The rest of the wound is carefully closed in layers. *In women when the abscess is in the pelvis and the diagnosis of the cause is doubtful* a low paramedian incision is chosen ; but when anterior drainage has to be adopted hernia is more likely to follow this. In every case the edges of the wound are protected with pads secured to the parietal peritoneum with long clips,

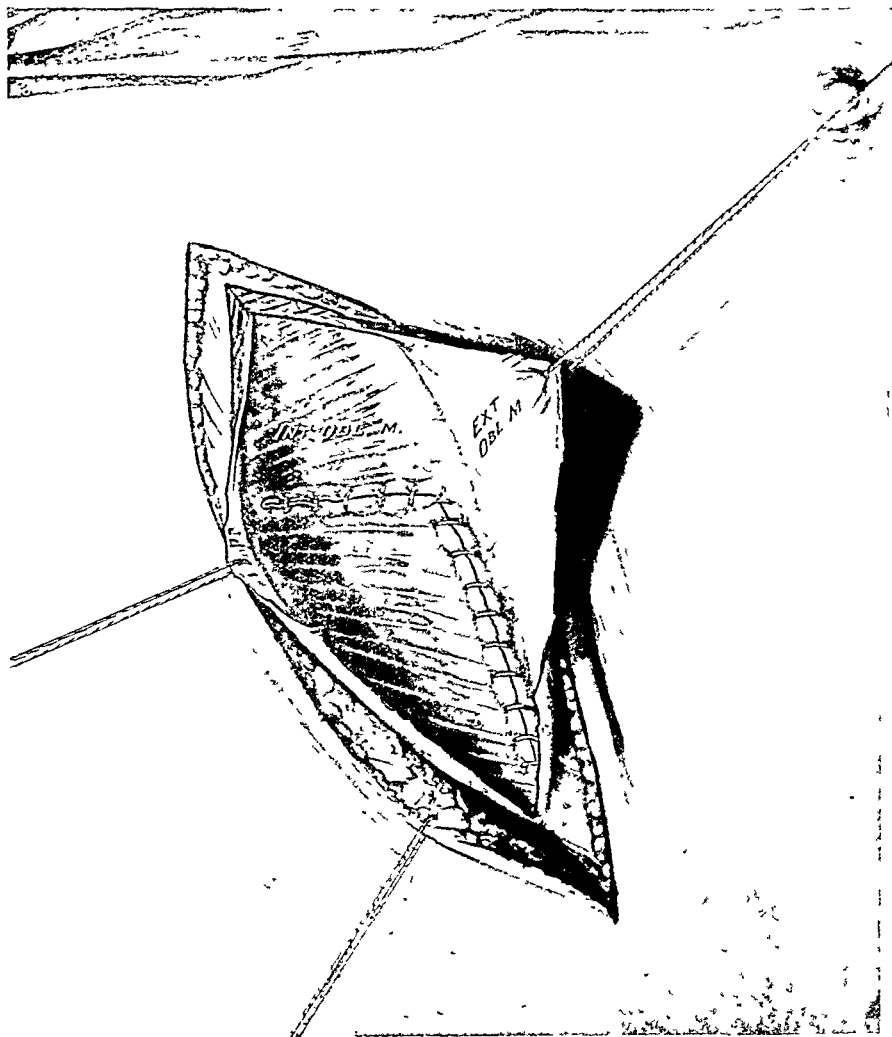


FIG. 230. Muscle splitting incision extended. The rectus sheath and the incision in the deep muscles have been closed.

and gauze rolls are passed into the right loin, left iliac fossa and lastly into the pelvis. Then the abscess is opened by gently separating the adhesions with the finger. All pus is mopped away most carefully before the appendix is sought. Adhesions are separated as far as necessary to display and deliver the appendix, great care being taken to avoid damaging the intestines by keeping close to the appendix or its mucosa. If possible the cæcum is delivered out of the wound and the appendix is removed as already described. In some cases the cæcum is thickened and friable so that inversion of the stump is not practicable. Then the latter is

tied and if possible covered by the meso appendix. In some cases it is not possible to deliver the appendix until the meso appendix has been clamped and divided and it is often easier to tie the mesentery after it has been clamped and divided so as to get the appendix out of the way. The part is thoroughly cleansed and a split rubber tube of at least half an inch internal diameter is passed into the abscess cavity behind and to the outer side of the caecum. When the abscess is in the loin a counter incision is made above the iliac crest and a tube is inserted (see Fig 53) the anterior incision being accurately closed. When the abscess is in the pelvis counter drainage is in suitable cases established through the vagina in the female but this method is rarely suitable for children or young girls. A long curved pair of forceps is introduced into the vagina which has been previously cleansed and forced through the posterior wall of the vagina into the pelvis. A hand in the pelvis protects the intestines and guides the forceps. The end of a long rubber tube is seized and drawn downwards until about one inch remains in the pelvis. This part has two side holes made in it to ensure efficient drainage. The lower end is fixed to the vulva by suture (see Fig 54). The tube is kept in for three days. This form of pelvic drainage hastens the recovery and does no harm. It often allows the abdominal wound to be closed and the risk of hernia to be thus avoided. In many cases a stab wound above the pubes and bladder serves well for the drainage of a pelvic abscess especially in the male and the risk of hernia or of secondary hæmorrhage here is very slight. When the tube has been placed the packs are withdrawn and the wound is closed. Usually the peritoneum is closed with catgut and the muscles or aponeurosis are also sewn with catgut unless there are reasons for hurry. Then all the layers down to the peritoneum are approximated with stout fishing gut sutures.

IS IT WISE TO REMOVE THE APPENDIX WHEN THERE IS A LOCALISED ABSCESS ?

It is a common error to believe that the appendix is destroyed by a localised abscess and therefore that it is unnecessary to remove it (a) either at the time of opening the abscess or (b) at a subsequent date. When the abscess is a large one of long duration the chance of the destruction of the appendix is greater than when it is small and of short duration. When a calculus is discharged some presume that the power of the appendix for evil is abolished. In 1905 there was a discussion upon this subject before the Medico Chirurgical Society when the statistics of a large number of cases were collected from various hospitals and from the private practice of several surgeons. The late Sir Frederick Treves then stated that recurrence of symptoms occurred in about 17 per cent of the cases in which the abscess was merely drained. The late Sir Alfred Pearce Gould gave a lower estimate of 10 per cent. It is probable that recurrence takes place in a higher proportion than was calculated by these and other authorities for their calculations necessarily had a comparatively short time limit. This is especially important to bear in mind as most of the subjects of appendicitis are young people with a fairly long expectation of life. If the life histories of all these patients could be followed up to the ends it is probable that recurrence would be found in at least 25 per cent. It will be noticed that in one of the cases illustrating this article the

symptoms came on after nine years of complete immunity. Judging from statistics of recurrences and from the findings at radical operations undertaken in the interval following abscess, operations for ventral hernia following long-continued drainage, and especially from the findings at operations for abscess, it is a rare event for the appendix to be completely destroyed by suppuration, and nothing short of this is sure to prevent recurrence of inflammation. Further, it is rare for *all* the appendix to lie in the abscess cavity, even when it is retro-cæcal. As a rule some part of it is free in the peritoneal cavity. For instance, it is common to find a perforation over a calculus near the tip of the appendix when the base is covered with comparatively healthy peritoneum in the general peritoneal cavity. Upon this important fact depends the risk of peritonitis at future attacks. Sloughing near the base of the appendix may lead to stricture with gradual distension of the terminal part, leading to future attacks. Case 1 is a good illustration of this.

CASE 1. *Appendical abscess drained. Recurrence within three months. Secondary operation.* A young lady, aged 15, had an appendical abscess opened on the sixth day of an attack in November, 1907. Before Christmas she was able to return home quite well. At the middle of January, 1908, she had several attacks of pain in the right iliac fossa, associated with vomiting and slight fever. It was therefore decided to remove the appendix.

Operation. The fibres of the oblique muscles were separated. The cæcum was found, but could not be delivered owing to extensive and firm adhesions. The appendix was found behind the cæcum and ascending colon. It was still inflamed. Its base was strictured, probably at the site of the previous perforation. The distal part of the appendix was greatly distended and contained muco-pus. It was removed in the usual way and the abdomen closed. The patient has remained well for many years.

(a) Until recent years it was not considered safe to seek the appendix in the wall of the abscess, and it was regarded a triumph if the abscess could be drained without opening the peritoneum. A great many lives have been saved by this course of treatment, and it is still the best plan to adopt *for late and large abscesses and for patients who are very ill* and by surgeons who are inexperienced in this special work. The removal of the appendix must add a little to the length of the operation, but with a skilful surgeon this addition is rarely sufficient to be so detrimental as leaving a diseased appendix in the abdomen. The risk of setting up diffuse peritonitis by removing the appendix is very small if proper precautions be taken. It is essential to recognise that the risk is not in opening the peritoneum, but *in setting free and leaving infective material in the peritoneal cavity*. The removal of the appendix entails opening the peritoneal cavity in the majority of these cases, for some part of the diseased appendix usually faces this cavity. This accounts for the known danger of seeking the appendix from within the abscess, especially when all the pus has not been mopped away. Therefore it is evidently necessary to take due precautions against the possibility of *overlooking a leak into the peritoneum*, before or during the removal of the appendix. There is only one certain way of preventing this catastrophe, and this is *by first deliberately opening the peritoneum internal to the abscess, and packing off carefully before the abscess is opened*. Whenever suppuration is suspected, three rolls of dry aseptic gauze are passed in order to the left iliac region, to the right loin and to the pelvis. It is important to place the two first packs before the

pelvis is invaded, because unsuspected pus is frequently found in the pelvis. The end of each roll is clipped to the towels. The parietes are also protected with fixed gauze pads, and then the abscess is opened. All the pus is mopped away, and when the cavity is dry the appendix is sought and removed, hindering adhesions being broken down if necessary. A tube half an inch in diameter is placed below and outside the cæcum, the packs are removed and the wound is partly but not tightly closed around the tube, which is not removed for two days. For the better drainage of a retro-cæcal abscess a tube is sometimes placed in a stab wound from the loin, and similarly vaginal or rectal drainage is adopted for some late pelvic abscesses, the anterior wound being closed. Occasionally an abscess, especially a very large one, is opened before the peritoneum is opened and therefore before the packs can be placed. Under these circumstances the appendix may be sought from within the abscess after taking the precaution of carefully mopping away all pus and blood, but this is neither so safe nor so easy as the method already recommended. It is not so safe because without opening the peritoneal cavity freely a pelvic abscess or even a spreading peritonitis may be overlooked, or infective material may leak into the pelvis through a small opening made in the wall of the abscess during the removal of the appendix. It is not so easy because without separating adhesions and exposing the peritoneal surface of the cæcum it is difficult either to identify and deliver the cæcum or to trace its longitudinal bands to the appendix. For these reasons, after mopping the pus away, I separate the adhesions in front and open the peritoneum and place packs before seeking the appendix. The disadvantages of leaving the appendix are considerable. I believe that complications are more likely when it is left, especially secondary abscesses, peritonitis, pulmonary complications and portal pyæmia. Intestinal obstruction and faecal fistula also seem to be more common. The long-continued drainage which is often necessary favours the formation of ventral hernia. Convalescence is often prolonged by sinuses and chronic septic absorption. Moreover time, money and opportunities are wasted by relapse, recurrence or the need of secondary operations either for abscess, peritonitis or for the removal of the appendix in the quiescent period. Case 2 is an excellent illustration of this.

CASE 2. Retro-cæcal appendix. Diffuse peritonitis twice. Several abscesses and empyema within ten months. Appendix removed during last attack of peritonitis. Recovery. A young man, aged 21.

History. About February, 1911, he was operated upon for appendicitis with peritonitis, being very ill at the time, and the surgeon hoped that the appendix had sloughed off. The abdomen was drained. About April, 1911, he had another abscess over the left iliac fossa drained. He had a sinus for a long time. He also had an empyema at the left base, which was drained posteriorly. He had another abscess opened in July, 1911. Since September, 1911, he has been very much better, has gained a good deal of weight, and has been doing his ordinary work without difficulty except that he has had a little indigestion for the last few weeks, and for five days consecutively he has vomited after dinner and has had a good deal of pain in the epigastrium immediately after eating. The bowels have acted fairly well. He took a dose of castor oil on the morning of November 21, 1911. He was seized with violent pain in the lower part of the abdomen on the right side at 6 P.M. on that day. He took some brandy, but this did not relieve the pain. I saw him for the first time at 8.30 P.M. on the 22nd. His abdomen was rigid and was very tender in the right lower portion, and there was a little redness and oedema of the scars over the appendical region. There was also tenderness in the left iliac fossa. The pulse was about 116, respiration 26, and temperature 101°.

Operation. I opened the abdomen through the right rectus internal to the old scars. Before the abdomen was opened I could feel a mass in the loin. Directly the abdomen was opened blood-stained pus escaped. This was very offensive. Packs were passed to the flanks and pelvis in order. The pelvis contained a fair amount of pus and lymph, and there were a great many adhesions between the coils of small intestine and between them and the anterior abdominal wall. The cæcum was unusually high, and the appendix could not be found at first, but a grey area indicated its situation. After some dissection it was found behind the cæcum and colon extending vertically upwards for six inches. Its distal two-thirds were in good condition, but its basal portion had recently perforated over a calculus, and was very adherent and difficult to isolate. It was removed and its base invaginated in the usual way, but its mesentery could not be identified and tied owing to dense adhesions. There was a good deal of oozing of blood. The packs were withdrawn. Three drains were inserted, one of gauze extending up behind the ascending colon, and two tubes containing wicks of gauze, one to the stump of the appendix and one just over the brim of the pelvis. The peritoneum was partly closed with catgut, and the rest of the wound above the drains sewn with mass salmon-gut sutures. The operation was a difficult one owing to the amount of adhesion and the difficulty of identifying the parts. A few days later an abscess was opened through the old empyema scar. The patient made a good recovery.

The removal of the appendix at the first attack or soon afterwards would have saved this patient a great deal of trouble. I did not see him until just before the last operation. The diagnosis had been difficult, owing to the vagueness of the early abdominal symptoms. Pneumothorax and subdiaphragmatic abscess had been suggested. The writer has had to operate in several similar cases. One patient, a boy aged 12, had had five operations for appendicitis in less than a year.

Conscious of the above-mentioned disadvantages and dangers, I decided, some twenty years ago, not to leave the appendix without some very good reason, such as the grave condition of the patient, and since then I have left it in only a few very late cases. Death and complications have been fewer since I adopted this plan. It is necessary to insist that the safety of the method depends on carefully carrying out in every case the precautions already mentioned. When such precautions cannot be taken it is better not to attempt to remove the appendix at the primary operation, but to be content with drainage and to remove the appendix at a later date.

(b) *The removal of the appendix at a subsequent date.* In a certain number of cases a secondary operation has to be undertaken, because a sinus or even a fistula refuses to heal. A lady was sent to me for fæcal fistula nine months after a drainage operation. I found and closed a cæcal fistula and at the same time removed a large ballooned appendix, all of which, except the strictured base, was lying free in the peritoneal cavity. I have removed similar appendices during operations for ventral hernia and for intestinal obstruction due to peritoneal bands extending from the appendix.

In other cases there are early relapses or the symptoms never subside; an induration persists in the iliac fossa, with pain and stiffness of the right thigh. Other patients suffer from chronic dyspepsia due to chronic appendicitis. Under these circumstances the patient welcomes or even urges a radical operation.

There is some difficulty and anxiety in advising a large group of patients who seem to be quite well. Unless there is some contra-indication to an operation, such as serious visceral disease, I think we ought to tell the

patient the chance of recurrence, and to point out that recurrent attacks are apt to be very deceptive and sometimes very dangerous. It is for the patient to choose between the slight known risk of a radical operation and the unknown risk of recurrence of a disease which carries with it a high mortality. When several years have elapsed without symptoms the patient may reasonably decide to take his chance. The following is an instance of a late recurrence.

CASE 3 *Acute appendicitis nine years after drainage of appendical abscess* Nine years ago a lady, aged 52, had a large appendical abscess drained. The appendix was not removed. The sinus went on draining for about six months and she gradually made a good recovery and remained very well until quite lately when she has had a little indigestion. On April 4, 1912, she was going abroad and was actually dressed ready to start when she was seized with very severe pain in the abdomen and fainted. Very reluctantly she had to abandon her trip. She had very great pain that day and vomited a good deal. She did not sleep that night and on the 5th the symptoms were the same only she was a little better. Her temperature did not go up to more than 100.4 and the pulse was never higher than 100, but the abdomen was full and rigid in the lower and right part. The patient looked ill and her medical attendant became anxious and asked me to see her on the 6th at 4.30 P.M. She said she was a good deal better but I thought this due to perforation of the appendix giving relief of tension and of pain. I strongly advised an operation and this was done just fifty-five hours after the onset of the attack.

Operation An incision was made *internal to the old scar* which was rather weak but not herniated. The lower part of the rectus was displaced inwards and the peritoneum opened. There was no pus free in the cavity. After passing packs into the flanks and pelvis the appendix was sought. The cæcum was very adherent to the old wound so that it was fortunate that the exploration was internal to the old one. The appendix was lying behind the cæcum. In separating it a few drachms of pus escaped on to the pack. The appendix was small, thick-walled, rigid and fibrous, possessing very little lumen. It was acutely inflamed. Its base was crushed divided between two artery forceps and then invaginated by a purse-string suture. Its mesentery was tied. The abdomen was closed in layers and a small rubber tube was placed in the superficial wound for temporary drainage. Catgut was used for the appendix mesentery and muscles and salmon gut interrupted sutures for the skin. A rectal saline was given immediately after the operation. The patient had an attack of diarrhoea and vomiting after the operation which gave rise to some anxiety but the pulse and temperature were normal and the attack soon subsided and the patient made a good recovery.

When an abscess has discharged spontaneously into the bowel, vagina, bladder or on to the surface it offers no greater safeguard against recurrence.

D OPERATION FOR SPREADING PERITONITIS DUE TO APPENDICITIS

When the cause of peritonitis is uncertain it is wise to use a right paramedian incision. Otherwise the McBurney incision is the best. The edges of the wound are protected. When the peritoneum is opened pus at once escapes. Rolls of gauze are passed into each loin and lastly into the pelvis. These absorb the collections of fluid while the appendix is sought and removed. The end of each roll is clipped to the towels so that none may be lost. In every case the pelvis is explored for otherwise a collection of pus may be overlooked. Unless there have been previous attacks or the present one is due to the rupture of a localised abscess it is easy to find the cæcum and to remove the appendix. In early cases the appendix is treated as already described. In grave cases it and its mesentery are simply but separately clamped, tied and divided. The

pelvic peritoneum is cleaned with moist gauze rolls, and the packs are removed. In late cases drainage is established, a split rubber tube containing a strip of rubber sheeting being passed behind the cæcum or towards the pelvis. In severe cases another tube is passed towards the pelvis or left loin through a stab wound above the pubis or over the left iliac fossa; but as a rule this is unnecessary. In early cases with only turbid serum in the peritoneum and no pus in the pelvis the abdomen is closed in layers, but it requires considerable judgment to know the cases in which this can be done with safety and advantage. In doubtful cases it is safer to leave a drain, and in many it is desirable to leave a small tube in the parietal wound on account of the risk of cellulitis, especially in old and stout people. The

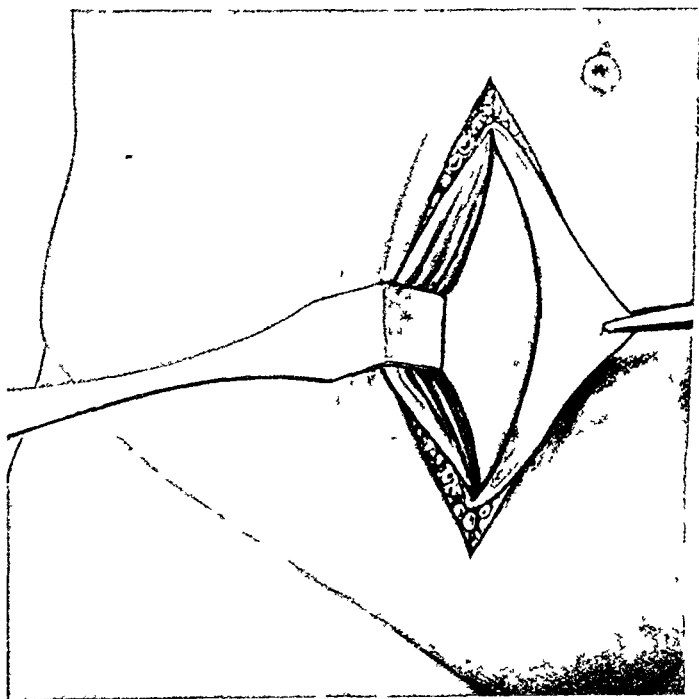


FIG. 231. Vertical incision for appendicectomy and pelvic operation. The rectus is drawn outwards, which is far better than drawing it inwards.

peritoneum can overcome an infection which causes trouble in the cellular tissues of the abdominal wall.

When a tube is inserted in the abdomen and the wound elsewhere is accurately closed in layers so that ventral hernia may be avoided. The tube should be removed within forty-eight hours.

The whole operation should be done speedily yet gently and carefully, and it rarely occupies more than twenty minutes, often only about ten minutes. The result depends much upon the skill of the operator, and upon the care bestowed upon the after-treatment (*see* Chap. I.).

Complications after Operation. Those common to all abdominal operations have been discussed in Chap. I., and some of those of appendicitis have been mentioned at page 387. With earlier operation they are becoming far less common.

(a) *After internal operations* Thrombosis especially of the left iliac veins or pulmonary embolism occasionally occurs especially in patients who are anæmic and in poor health following severe attacks of appendicitis. The best way to prevent these complications is by getting the patients up early not later than the fifth day after the operation.

(b) *Of suppurative appendicitis*

(1) Intestinal obstruction from kinking and paralytic distension or from peritoneal bands constricting the lower ileum

(2) Continued peritonitis and septicæmia

(3) Portal pyæmia

(4) Pulmonary complications such as empyema pleurisy and pneumonia

(5) Secondary abscesses especially pelvic and subdiaphragmatic

(6) Faecal fistula especially from the ileum or from the cæcum at or near the stump of the appendix

An abscess may burst into the rectum bladder or vagina and some times a fistula results

(7) Thrombosis of the iliac femoral or saphena veins Pylephlebitis

(8) Pulmonary embolism

Love¹ found the following complications during attacks in 1803 cases secondary abscess 52 subdiaphragmatic abscess 9 faecal fistula 74 phlebitis 7 intestinal obstruction 19 parotitis 1 empyema 2 pleurisy 4 pulmonary embolism 1

INFLAMMATION AND PERFORATION OF MECKEL'S DIVERTICULUM

This may closely simulate appendicitis and intestinal obstruction and may result in (a) simple catarrhal inflammation without infection of the peritoneum (b) formation of a localised abscess or (c) perforation or gangrene leading to diffuse suppurative peritonitis which is relatively more common and more serious than the peritonitis arising from the vermiform appendix. The cause of the trouble is rarely diagnosed before an operation is undertaken for the relief of intestinal obstruction or for the treatment of peritonitis generally considered to be of appendical origin. This condition is more fatal than appendicitis for several reasons the greater size larger lumen of the diverticulum and free communication with the bowel favour faecal extravasation from a perforation the greater freedom and more median position of this unusual appendage are also unfortunate for localisation of inflammatory products and extravasations arising from it and lastly intestinal obstruction often co-exists and a kink or volvulus at the base of the diverticulum may cause obstruction of both it and the small intestine at the same time. A gangrenous or perforative inflammation of the obstructed diverticulum is likely to occur and to lead to peritonitis in a few hours.

Gibbon² Clinton³ Dineur⁴ Oliver Ashe⁵ Roberts⁶ Oliver Smith⁷ and others record interesting cases of this kind. Smith quotes Blanc⁸

¹ *Loc. supra cit.*

² *Amer Journ Med Sci* November 1903

³ *Pittsburg Med Journ* June 1904

⁴ *Journ Méd de Bruxelles* November 5 1903

⁵ *Lancet* August 29 1903

⁶ *Ann of Surg* July 1906

⁷ *Ann of Surg* 1904 xl "44

thesis to the effect that of twelve cases of acute inflammatory and perforative diseases of the diverticulum eight died and three recovered after operation, the result being uncertain in the other cases. Gordon Taylor¹ records a case of gunshot injury of the diverticulum.

Halstead² has related two fatal cases of perforation occurring during the second and fourth weeks of typhoid fever; he also mentions two other fatal cases reported by Galton and Boinet, and he points out that perforation is very likely to occur at the fundus, because the muscular wall may be deficient there. Tuberculous ulceration with perforation may also occur, although it is infinitely rare as compared with inflammation following sudden or chronic obstruction and the formation of faecal concretions.

The treatment of this rare disease should be carried out along the lines laid down for appendicitis and its complications, for which the operation will have been undertaken as a rule. The diverticulum should be removed and its base crushed, tied and inverted by purse-string or Lembert's sutures; but this may not be always possible, owing to the constriction, volvulus or gangrene of the small intestine, which may call for resection or primary drainage with secondary resection in bad cases with paralytic distension existing or threatening.

PERFORATION OF TYPHOID ULCER

The diagnosis of this accident, which occurs in about 2·5 to 4·9 per cent. of all cases of enterica, is very important. Perforation accounts for at least a third of the deaths from typhoid fever.³

Unfortunately it is very difficult to arrive at a diagnosis, for few of the classical symptoms and signs of perforation present themselves when perforation occurs during the depressed and almost moribund stage of the fever; a number of perforations are therefore not suspected until they are discovered at the autopsy. In others the diagnosis is only made when signs of peritonitis become evident, and an operation offers but a forlorn hope; peritonitis may occur without perforation.

Without operation perforation practically implies certain death, although rare and undoubted cases of spontaneous recovery have been recorded. Goodall relates one interesting case of this kind; the recovery occurred in one out of 68 cases which were not treated by operation, giving a rate of recovery of 1·4 per cent. for this series, and this is unduly hopeful.

The results of operation for this condition during recent years have made a steady improvement. In a list of 83 cases which Keen⁴ gives, there were 16 recoveries; 19·2 per cent. of the operations, therefore, were successful.

Harte and Ashhurst⁵ collected the records of 362 cases treated by operation, and found that 26 per cent. of these had recovered, but these figures are far too favourable, for all the successful cases are published hurriedly, whereas the records of failures are buried in oblivion. Goodall⁶

¹ *Brit. Journ. Surg.*, 1918, vi, 324.

² *Med. Record*, November 29, 1902.

³ Harte and Ashhurst, *Ann. of Surg.*, 1904, xxxix, 8; Goodall, *Lancet*, 1904, ii, 9.

⁴ *Surgical Complications and Sequelæ of Typhoid Fever*, 1898.

⁵ *Loc. cit.*

⁶ *Loc. cit.*

mentions 49 *consecutive* operations at the Metropolitan Fever Hospitals, with four recoveries, or 8 per cent

Elsberg¹ records 25 cases of typhoid perforation in *children*, with 16 recoveries, the prognosis is known to be much better in children Jobson and Gitting² record 22 recoveries in 44 children

Woolsey³ records 17 consecutive hospital cases, with a mortality of 76.4 per cent and F T Stewart⁴ publishes 8 cases, with 2 recoveries Meakins⁵ records 1 230 cases of typhoid with 32 perforations, 20 operations, and 5 recoveries Twenty cases were operated upon at the Johns Hopkins Hospital⁶ with 7 recoveries It is not probable that the percentage of recovery in *any series of a large number of consecutive cases* will be above 30 for many years to come, but this would be a brilliant success for a condition which is practically certain to be fatal unless an operation is done

This improvement is doubtless largely due to earlier diagnosis of the condition, and therefore earlier operation, and as the feasibility of the operation becomes more fully recognised by physicians and surgeons alike, a still greater proportion of successes will no doubt be obtained Keen may be quoted on this point He says "When once the physicians are not only on the alert to observe the symptoms of perforation but when the knowledge that perforation of the bowel can be remedied by surgical means has permeated the profession, so that the instant that perforation takes place the surgeon will be called upon and if the case be suitable, will operate, we shall find unquestionably a much larger percentage of cures than have thus far been reported" But although earlier diagnosis will do much to render these cases more hopeful, it must not be forgotten that many of them will still be practically hopeless from the first, on account of the serious condition of the patient, the delay in diagnosis, and of the technical difficulties which the surgeon will have to face

Diagnosis The sudden onset of acute pain, especially in the right lower quadrant of the abdomen, accompanied by unusual tenderness and rigidity, strongly suggests the occurrence of perforation Shivering is also an early sign, on which Goodall lays stress Collapse of any marked degree is unusual, and its absence should not be allowed to mislead The affected loop of bowel may lie in the pelvis, where its perforation may cause pelvic peritonitis with vesical and rectal symptoms, such as frequent and painful micturition, rectal tenesmus and excessive tenderness on rectal examination A blood count is of no certain value except that the absence of any marked decrease in the number of red corpuscles indicates that the symptoms are not due to hidden intestinal hæmorrhage Leucocytosis does not develop soon enough to be of value An obliteration of the liver dulness if it occurs when the abdomen is flat may be of importance in confirming the diagnosis in a few cases, but its absence is not to be depended on It should not be forgotten, however, that symptoms of perforative peritonitis may come on insidiously in typhoid fever, and that a patient may die with unsuspected general suppurative peritonitis, also

¹ *Ann of Surg*, July, 1903

² *Amer Journ Med Sci*, November 1903

³ *Ann of Surg*, 1906, 1 652

⁴ *Amer Journ of Med Sci*, May 1904

⁵ *Montreal Med Journ*, October, 1905

⁶ Sir Wm Osler, *Principles and Practice of Medicine*, 8th ed., 1920, p 11.

that the collapse and exhaustion of the third week may simulate perforation. Further, it is not uncommon for the signs of perforation to subside for a time after the initial sharp onset of pain. This stage is very deceptive. Appendicitis occurring during enteric fever is difficult to distinguish from perforation of an ulcer. The writer has successfully removed the appendix in two cases of this kind.

Every effort must be made to arrive at an early diagnosis, however, and for this reason a surgeon should be asked to see the case when any suspicion arises, so that he may share the responsibility and operate without delay if necessary. When there is a strong suspicion of the occurrence of a perforation, an exploration should be undertaken and carried out as rapidly as possible if a capable surgeon is available. A blank exploration under favourable circumstances is not necessarily a very serious thing. Harte and Ashhurst give the following account of operations of this kind :

“Of 26 such operations in which no peritoneal lesions were found, 16 patients eventually recovered ; only 10 died—a mortality of 38·46 per cent. Of the nine fatal cases in which the duration of life after operation is known, only three died in less than twelve hours. Of these three, one (Finney) died from pulmonary embolism following iliac thrombosis ; the second (J. F. Mitchell) had had severe hematemesis and enterorrhagia shortly before operation and was in a very precarious condition ; while in the third case (Le Conte), in which the patient lived nearly seven hours after operation, the toxæmic state previously existing persisted without material change until death. In these three cases local anæsthesia was used, and in no way can the exploratory incision be held to have had any connection with the fatal termination.”

The success of treatment depends very much upon early operation, without waiting for reaction from any collapse that may be present. To avoid delay in getting consent from the relations it is wise to explain to the latter, early in the disease, the chances and dangers of perforation and to get their consent to immediate operation if perforation takes place. Armstrong¹ found that ten operations performed during the first twelve hours were followed by four recoveries, whereas the same number of operations done during the second twelve hours were followed by only one recovery. All those operated upon after twenty-four hours died. Harte and Ashhurst's figures do not show the same striking effect of delay :

ANALYSIS ACCORDING TO DURATION OF PERFORATION BEFORE OPERATION.

Cases operated on.	Recovered.	Died.	Total.	Mortality.
First 12 hours after perforation . . .	35	95	130	73·0%
Second	22	62	84	73·8%
Third	2	29	31	93·5%
Over 36 hours	18	37	55	67·2%

(Harte and Ashhurst)

and it is to be noticed that operations performed after thirty-six hours gave a mortality of only 67·2 per cent., but these cases were the few mild cases of slight and localised extravasation that had survived long enough to require an operation at this late period. Armstrong² reports seventy-eight operations with twenty-four (or 30·7 per cent.) recoveries.

¹ *Ann. of Surg.*, November, 1902.

² *Brit. Med. Journ.*, October 29, 1910.

The cases may be divided into two different classes—the first, in which perforation takes place during the height of a severe attack, the second in which the perforation occurs during convalescence or a mild relapse. In the former class the prospect is almost hopeless from the first, in the latter however there is a considerable chance of success.

Two anatomical points should be remembered in connection with operation. (1) *That the perforation nearly always occurs in the last few feet of the ileum.* According to Keen it is in the ileum in 81·4 per cent. Harte and Ashhurst found that in 110 cases out of 190 the perforation was within a foot of the cæcum and in only four was it more than a yard away from the ileo-cæcal valve. The appendix was found perforated in eight cases and Meckel's diverticulum in three. The large intestine was perforated in 22 out of 232 recorded by Hector Mackenzie.

(2) *That more than one perforation may be present.* In Keen's list there were two or more perforations in 16·7 per cent. Harte and Ashhurst found that more than one perforation had occurred in 12 per cent. of 271 cases.¹ In a man aged 38 Wroth² found four perforations in the ileum. The patient recovered after a lateral anastomosis for faecal fistula. In some cases peritonitis occurs without any perforation.³

Operation. Owing to the feeble condition of the patient this calls for speedy, gentle and accurate work. It is carried out on the same lines as those described for acute appendicitis with peritonitis. Sometimes local or spinal anaesthesia is adopted.⁴ Gas and oxygen is the safest general anaesthetic. The right paramedian incision is the most suitable and gives good access to the lower ileum and cæcum. When the peritoneum is opened packs are placed to soak up the extravasation and the cæcum is taken as a guide to the lower end of the ileum and the latter is followed up. Adherent lymph or lines of intense inflammation often indicate a perforation and sometimes an escape of gas or liquid faeces. As soon as a perforation is found the coil is brought outside and surrounded with warm moist pads. A small perforation or a threatening one is invaginated with a sero-muscular purse-string suture of fine linen thread. A large opening is closed with a continuous Connell reinforced by a continuous Cushing suture. Occasionally an omental graft may be used to plug and close a large perforation with friable walls.⁵ In some cases an enterostomy is performed. a perforated appendix or Meckel's diverticulum is removed.

Occasionally it is not possible either to find or close a perforation but if free drainage is provided the patient will have a better chance of recovery than if the operation is unduly prolonged by vain attempts to close the opening or to bring it to the surface or worse still resect a

¹ *Lancet*.

² *Ann of Surg.* November 1909.

³ Svartz and Hansen *Acta Med. Scand.* 1920 21, lix 97.

⁴ Novocain local anaesthesia may be used in some cases. (a) For exploratory purposes in cases of grave doubt a small incision may be made the lower three or four feet of the ileum rapidly examined and a rubber tube passed into the pelvis and aspirated to find if any free fluid is present there. (b) for bad cases where a general anaesthetic may be considered too hazardous. Dr G. L. Hays (*Amer. Med.* September 6 1902) records seven cases treated under local anaesthesia. Three of his patients recovered. The handling of the intestines and the retraction of the wound are painful and the mental distress produces shock however. Goodall found eucaine to be unsatisfactory in the only case in which he tried it.

⁵ Le Conte *Phil. Med. Journ.* December 13 1902.

portion of the bowel. As a rule the patient is too feeble to stand such heroic and prolonged operations. Moreover, the fæcal fistula soon closes spontaneously if the bowel is not fixed to the wound but is left among neighbouring coils, with a tube containing a gauze wick reaching down to the perforation. With multiple perforations enterostomy is sometimes necessary.

The peritoneum is cleansed with gauze rolls passed into the pelvis and flanks and left there to soak up the extravasation while the perforation is sought and closed. This is safer and speedier than irrigation. The packs are removed and the wound is closed either partly or completely. Usually drainage is required by means of a tube passed through a suprapubic stab wound into the pelvis. When the extravasation is local and early the wound is completely closed.

DIVERTICULITIS OF THE COLON ¹

The earliest description of diverticula of the colon is that published by Cruveilhier² in 1849. In the English and American literature on the subject his important work appears to have been entirely overlooked. Curiously enough, Virchow³ is generally credited with the first account of the condition, although on looking up the reference we find that the *diverticula coli* about which he wrote are simply the haustra of the colon which bulge out between the longitudinal bands, and he makes no reference whatever to the pathological condition now known as diverticula.

Though Bristowe⁴ had shown a typical specimen of multiple diverticula of the colon to the Pathological Society of London in 1855, the first author to describe the condition in the English language was Habershon,⁵ physician to Guy's Hospital, who in 1857 wrote the following excellent account of diverticulosis :

"Pouches of the colon sometimes become of a considerable size ; generally the circular fibres of the canal surround them, but not very unfrequently the circular fibres yield, and the mucous layer projects, covered only by the peritoneum, forming a more elongated sac, filled with mucus, or more frequently fæces. The orifices of these small sacs are bounded by the hypertrophied and longitudinal fibres, and their contents remain almost shut off from the intestinal canal. These pouches are the result of constipation, the muscular fibres become hypertrophied, but their effort to propel onward their contents leads to these minute hernial protrusions.

"I have most frequently observed them in connection with the sigmoid flexure ; but they probably occur at any part where the longitudinal fibres form a triple band rather than a uniform layer. In one case they were situated about every half-inch, forming a double row on each side of the colon. No muscular fibres could be detected in several of them, beyond the immediate vicinity of the mouth of the sac, but

¹ The description of this disease is an extract from an article by A. F. Hurst and R. P. Rowlands in the *Guy's Hospital Reports*, 1925, lxxv, No. 4, p. 462.

² J. Cruveilhier, *Traité d'Anatomie Pathologique*, 1849, i, 593.

³ R. Virchow, *Arch. f. path. Anat.*, 1853, v, 348.

⁴ J. E. Bristowe, *Trans. Path. Soc.*, 1855, vi, 191.

⁵ S. O. Habershon, *On the Diseases of the Alimentary Canal*, London, 1857, p. 296.

merely mucous membrane, submucous cellular tissue, fat and peritoneum. These pouches do not appear to produce any symptoms, or lead to dangerous result.

In 1885 Arbutnot Lane¹ described in the Guy's Hospital Reports a specimen of diverticula in a partially obstructed loop of colon found in a hernial sac and associated with diverticula of the bladder—the paper is of special interest as it contains the first published illustration of the condition.

These early observations attracted very little attention and it was not until the work of Beer² in 1901 and of Maxwell Telling³ who in 1908 collected 83 cases from the literature and added 21 new ones that the pathological and clinical importance of the condition at last became generally recognised. In 1917 Maxwell Telling published with Gruner a further paper founded on the study of 321 recorded cases.

Up to 1913 diverticula of the colon were always an accidental discovery at operation or post mortem. In that year de Quervain⁴ in Switzerland and subsequently one of us (A. F. H.) in England and Case in America diagnosed the condition with the aid of the X rays. Radiology has since shown the frequency of diverticulosis in which diverticula are present without producing symptoms and has proved that their inflammation—diverticulitis—far from being a pathological curiosity as it was regarded for over fifty years after Cruveilhier's classical description is really the most common cause of pain in the left iliac fossa.

The surgical aspects of diverticula of the colon have been predominant in the literature since 1907 when Mayo, Wilson and Giffin⁵ reported five cases treated by operation but the comparative ease with which the condition can now be diagnosed in its early stages has led to the gradual development of medical treatment which should eventually render operation only necessary in exceptional cases.

Results. Diverticula of the iliac and pelvic colon give rise to no symptoms unless pathological changes occur in them. Owing however to the stagnation of fecal material within them they are very liable to inflammation. Ulceration takes place and as a result of the thinness of their walls their peritoneal covering becomes infected. The wall of the bowel is thickened, the mesentery thickened and shortened and adhesions form especially to the bladder.

The irregular sausage shaped tumour formed by the inflamed colon has been frequently mistaken for cancer, especially when symptoms of chronic or acute obstruction have been present. In very chronic cases the development of fibrous tissue produces a tumour, which even during an operation or at the autopsy has been mistaken for a growth until microscopic examination showed its inflammatory origin and careful dissection revealed the presence of long and tortuous diverticula in the mass. In other cases the tumour has been left as inoperable, but the subsequent complete recovery of the patient has revealed its true nature.

¹ W. A. Lane *Guy's Hosp. Rep.* 1885 xliii, 48.

² E. Beer *Amer. Journ. Med. Sci.* 1904 cxxviii, 135.

³ W. H. M. Telling *Lancet* 1908 i, 813 and 1908, and 1920, 85 and with O. C. Cruner *Brit. Journ. Surg.* 1917 iv, 468.

⁴ F. de Quervain *Zeits. f. Chir.* 1914 cxxviii, 67.

⁵ W. J. Mayo, B. Wilson and H. Z. Giffin *Surg., Gyn. and Obst.* 1907, v, 8, 111.

Symptoms and Diagnosis. The mere presence of diverticula of the colon—the condition to which de Quervain has given the name of diverticulosis—gives rise to no symptoms. It is often discovered in the routine X-ray examination with a barium enema of patients suffering from constipation and other intestinal disorders. If systematically looked for in constipated but otherwise healthy individuals over the age of forty, diverticulosis would probably be found to be a quite common condition. Its sole importance is that under certain conditions the diverticula become inflamed and the condition of diverticulitis results.

The earliest descriptions of the clinical aspects of diverticulitis were published by surgeons who had operated upon advanced cases which had given rise to serious symptoms. Since it has become possible to diagnose the condition with comparative ease by means of the X-rays,¹ it has gradually become recognised that a mild form of diverticulitis is not uncommon, and that it gives rise to much less obvious and severe symptoms than those which were originally described. Many cases of intestinal dyspepsia, often diagnosed vaguely as colitis, are really due to diverticulitis. In any patient over the age of forty or forty-five, who complains of attacks of discomfort in the lower part of the abdomen, and especially in the left iliac fossa, associated with constipation, irritability of the bladder, and occasionally with slight pyrexia, the possibility of diverticulitis should be considered. In such cases there is always definite tenderness in the left iliac fossa and often on deep pressure just above the pubes. In the early stages the iliac colon may appear to be slightly thickened, but no definite tumour is present. A tender tumour in the left iliac fossa is frequently due to diverticulitis, the iliac colon being affected either alone or with the pelvic colon and occasionally the descending colon in a large majority of cases of diverticulitis.

In more advanced cases the symptoms are those of an acute inflammatory condition simulating appendicitis, but on the opposite side, or of chronic intestinal obstruction simulating cancer of the colon.

(a) *Inflammatory type.* Acute inflammatory attacks may occur, which are exactly similar to those of appendicitis, except that the local signs are on the left side. In cases of doubt the X-rays not only show the presence of diverticula, but they visualise the appendix and show that it is in its usual position; at the same time the tender area is found to be over the iliac and pelvic colon and not the appendix. The attacks may begin quite suddenly with acute pain after a heavy meal, whilst straining at stool, and after an aperient or during the administration of an enema, all of which produce active peristalsis of the colon, which might tear adhesions formed by inflamed diverticula. In other cases pain has occurred whilst at work, lifting a weight, jumping, hunting, or travelling in a jolting motor-car, and acute symptoms have developed after an operation on some other part of the abdomen.

All degrees of inflammation occur. Sometimes perforation takes place with the formation of a localised abscess, which may discharge into the bowel, vagina or bladder, sometimes with the formation of a temporary

¹ E. I. Spriggs, *Brit. Journ. Surg.*, 1920, viii, 95; and with O. A. Marxer, *Duff House Papers*, 1923, i, 165.

or permanent fistula but especially a vesico colic fistula. In others the abscess or the original perforation opens into the peritoneum and sets up a spreading peritonitis. One of us (R. P. R.) has operated on three cases of late diffuse peritonitis due to this cause with two deaths. It is important to remember diverticulitis as a possible cause of peritonitis of obscure origin.

(b) *Obstructive type* Diverticulitis often produces symptoms almost indistinguishable from those of cancer of the colon. In 1906 Moynihan¹ showed that fibrous stenosis of the colon due to diverticulitis may mimic cancer of the colon. One of us (R. P. R.) published two cases of chronic obstruction of the pelvic colon due to this cause.² The specimen successfully removed from one of the cases is in the Museum at Guy's Hospital. It shows very well the presence of diverticula along the mesenteric border with perforation into the mesentery which is occupied by a mass of inflamed tissue with necrotic areas and small abscesses. A great many cases of local inflammation of the colon with or without obstruction and due generally to diverticulitis have in the past been considered to be due to malignant disease. It is therefore of vital importance to make microscopical examinations of supposed growths of the colon and also to examine all specimens for diverticula. It is often not at all easy to find these even when the bowel is laid open. Sometimes they can be found only by the careful use of a probe. It is probable that patients who survive more than four years after a colostomy for supposed growth of the pelvic colon are not really suffering from cancer but from simple stenosis due to inflammation extending from diverticula.

The sigmoidoscope is useful in excluding a growth of the rectum or lower six inches of the pelvic colon. In some cases the lumen of the bowel is seen to become progressively more narrow and more or less fixed at a point proximal to the pelvic rectal flexure. The mucous membrane is generally normal in appearance. Occasionally it is red and swollen in the affected region but it never bleeds on simple contact with the instrument and it is never ulcerated as it frequently is immediately below a malignant stricture because the inflammation is generally confined to the outer coats of the bowel and to the mesentery. Diminution in the lumen of the bowel and swelling of the mucous membrane may make it difficult to see the openings into the diverticula. They are also likely to be hidden by folds of mucous membrane but Bensaude³ and others have seen them in a few cases. In one case of Mayo's the tumour had become partly intussuscepted into the rectum and was seen with the sigmoidoscope.

The stools rarely contain any pus or blood recognisable by the naked eye or microscopically and occult blood is generally absent. This is a very important point in diagnosis as even in the absence of obvious blood occult blood is always present both in primary cancer of the colon and in cancer associated with diverticulitis.

In most cases pyrexia and a moderate degree of polymorphonuclear leucocytosis are present both being comparatively rare in cancer. The secondary inflammation results in more pain than is common in growth

¹ *Trans Clin Soc* 1907 xl 38

² R. P. Rowlands *Lancet* 1910 1194

³ R. Bensaude, A. Cahn and P. Hillemand *Ann de Med* 1923 v 33

apart from the colic due to obstruction. The long duration of symptoms with little or no wasting, cachexia or anæmia, and the frequent history of life-long constipation are further points in favour of diverticulitis.

Occasionally diverticulitis and carcinoma of the colon are associated, but Judd and Pollock¹ believe that a patient with diverticulitis is no more likely to develop cancer than an average individual. In some cases a growth in the rectum or lower end of the pelvic colon has led to partial obstruction, and the increased internal pressure in the segment of bowel immediately proximal to it has doubtless been an important factor in the pathogenesis of the diverticula.

Vesico-colic Fistula. Frequency of micturition and discomfort in the bladder are common symptoms of diverticulitis, and their association with other signs of intestinal disorder should suggest the likelihood of this diagnosis. The bladder irritability is doubtless due to adhesions between the inflamed colon and bladder. In the presence of such adhesions an ulcerated diverticulum or an abscess which has formed in connection with one may rupture into the bladder. Cripps² was the first to show that a vesico-colic fistula results much more frequently from inflammatory changes in the colon than from cancer. A case published by Sydney Jones³ in 1858 proved that ulceration and perforation of a diverticulum might produce a vesico-colic fistula, and the investigations of Telling proved that this is its usual cause. One of us (R. P. R.) has operated on several cases of the kind.

Radiological Diagnosis. The X-rays afford the only means of recognising the presence of diverticula of the colon with certainty. Both an opaque meal and an opaque enema should be used; although the latter is much more likely to demonstrate the presence of the diverticula, the former helps to determine what effect they are exerting on the normal intestinal activity. In many cases the diverticula escape recognition after the opaque meal, but the degree and localisation of any delay in the passage through the colon, the exact situation of any area of tenderness, and the presence of fixation caused by adhesions can be studied. When an opaque enema is given, it may be held up temporarily or permanently in some part of the pelvic or iliac colon, showing that a considerable degree of obstruction is present, or, if it passes without difficulty, any local or widespread diminution in the lumen of the bowel is recognised. It is important to remember that a barium enema may give an exaggerated idea of the degree of obstruction, as the narrowing caused by the contraction of newly-formed fibrous tissue and by the presence of inflammatory material may be greatly increased by spasm; the latter is only temporary and is likely to be increased by the mechanical stimulus caused by the distension following the injection of the enema. If there is any evidence of narrowing, whether organic or functional, it is clear that diverticulitis and not merely diverticulosis is present.

During the administration of the opaque enema the diverticula may be recognised. But their exact relations and their number can only be determined with accuracy if the patient is re-examined after the greater

¹ E. S. Judd and L. W. Pollock, *Ann. of Surg.*, 1924, lxxx, 425.

² W. Harrison Cripps, *The Passage of Air and Faeces from the Urethra*, London, 1888.

³ S. Jones, *Trans. Path. Soc.*, 1858, x, 131.

part of the enema has been evacuated. The diverticula remain filled, and there is generally still a small quantity of the opaque fluid present in the lumen of the bowel which is no longer distended. Two rows of small rounded shadows with narrow necks connecting them with the intestinal lumen can generally be recognised. They are often still visible twenty-four hours or even several days after the enema has been given.

Treatment of Diverticulitis. (a) *Medical Treatment* The medical treatment of diverticulitis consists in complete rest in bed till active inflammation, as shown by the presence of pain, tenderness, muscular rigidity, pyrexia and leucocytosis, has disappeared.

From six to eight ounces of liquid paraffin are run into the bowel by rectum every evening and are retained during the night. By this means hard faeces in the iliac and pelvic colon and in the diverticula are softened and evacuated the following morning either spontaneously or after the administration of a pint and a half of warm water introduced slowly at as low a pressure as possible. No aperient is given, but atropine should be administered to counteract the spasm which is almost invariably present, gr 1/100th three times before meals can be tried as an initial dose, which should be increased if no unpleasant degree of dryness of the mouth or ocular symptoms arise.

When the signs of inflammation have disappeared the volume of the paraffin enema can be slowly reduced and finally paraffin given by mouth can be substituted for it beginning with one ounce three times a day and gradually reducing the quantity till the right dose is found sufficient for producing one or two soft, unformed stools a day.

By treatment of this kind we have found it possible not only to cure the slight cases in which the question of surgery could hardly arise but even to relieve severe cases in which obstructive symptoms and an acutely tender inflammatory mass, accompanied by pyrexia and leucocytosis, were present. It is generally possible to avoid an operation in the acute stage, when it is most dangerous.

(b) *Surgical Treatment Indications* If the medical treatment already described does not lead to rapid improvement in obstructive or acute inflammatory cases an operation should be performed without further delay. In more favourable cases, if in spite of careful after treatment the symptoms recur, it is probably wise to operate as soon as they have again subsided, as in a quiet, afebrile period a radical operation may be hopefully undertaken and completed at one sitting. In the very exceptional acute cases in which the signs suggest a spreading peritonitis, immediate operation gives the only hope of saving life. In any case in which it proves difficult to exclude carcinoma, either primary or complicating diverticulitis, operation should also be advised.

Choice of Operation It is often difficult to decide upon the best treatment even when a correct diagnosis has been made either before or at the operation. Telling¹ has drawn attention to the fact that these patients are particularly susceptible to infection. Peritonitis and suppuration of the abdominal wall have followed in too many cases because of the lurking infection in, and especially around, the affected colon. It is very important to prepare the patient carefully and to take every precaution

¹ *Loc supra cit*

against infection. It is wise to defer radical operation for at least a month from the end of a febrile attack.

The following operations may be briefly discussed :

- (a) Excision of diverticulum.
- (b) Colostomy.
- (c) Short-circuiting.
- (d) Resection.
- (e) Closure of colico-vesical fistula.
- (f) Treatment of abscess and peritonitis.

(a) *Excision of Diverticulum.* Excision of one or more diverticula is indicated when the disease is limited to one or a few. It has been successfully performed both for acute and chronic diverticulitis, but symptoms are apt to recur after it, because other diverticula are often present but unperceived and these may become inflamed at any time.

(b) *Colostomy.* Colostomy affords much relief without great risk to life, but an artificial anus has so many obvious disadvantages as to make it undesirable for sensitive patients. As a temporary measure it may be tolerated, when primary resection or short-circuiting is not safe or is impracticable at the time. It is particularly objectionable for the permanent treatment of patients who are not suffering from malignant disease and may be expected to survive for many years. It is of the utmost importance to bear in mind that what appears to be an obvious malignant growth of the pelvic colon may be only inflammatory. The mistake may be made even when the abdomen is opened. When operating for acute, following upon chronic, intestinal obstruction or when performing colostomy because a supposed growth is too adherent and extensive for removal, it may be useful to remove a small piece for microscopic examination. It must be remembered, however, that a good deal of inflamed tissue surrounds a growth, so that too much reliance must not be placed upon a negative report. Occasionally the rest, drainage and irrigation afforded by the colostomy may lead to partial or even complete disappearance of the stricture so that the artificial opening may be closed, but the trouble may recur. In other cases a temporary colostomy or valvular cæcostomy may be followed by secondary resection of the diseased part of the colon with restoration of the continuity of the bowel. In many cases this is the safest plan.

(c) *Short-circuiting.* It is unfortunate that the disease is usually in a part of the colon which is difficult to short-circuit. Moreover, the anatomical relations are greatly altered by the disease. The mesosigmoid is shortened and thickened and the inflammation may extend to the descending loop of the pelvic colon, so that it is almost impossible to make the anastomosis in healthy bowel below the disease; however, with the aid of a rubber tube, it may be possible to join the cæcum to the front of the rectum. In one case in which a tubular stricture extended from the rectum to the splenic flexure I anastomosed the ileum laterally to the front of the rectum, thus affording incomplete but considerable relief, the patient surviving in fair health for at least fifteen years. When the stenosis is high up, as, for instance, in the splenic flexure or descending colon, a short-circuit can be easily performed.

(d) *Resection* Resection with end to end union appears to be the operation of choice, for it offers a good chance of cure at one operation without undue immediate risk. In some of these cases it is much easier and safer to make the end to end anastomosis with the aid of a large rubber tube inside the rectum and colon. It is necessary to prepare the patient carefully by dieting aperients and enemata before undertaking the operation. It is wise to wait until any acute attack of inflammation has subsided. I have performed this operation in thirteen cases with one death from peritonitis. In this case the anastomosis low in the pelvis, was unfortunately not made over a rubber tube.

The ultimate results have been very good. The two following cases are good examples of this condition.

Resection of pelvic colon for diverticulitis simulating carcinoma Mrs M T aged 59 had suffered from constipation all her life but this had been worse lately. In 1922 she had an attack of abdominal pain which was thought to be due to kinking of the bowel. The pain was very severe requiring an injection of morphia. The attack was accompanied first by diarrhoea then by severe constipation. The temperature was above normal for a fortnight. Two weeks later another attack developed accompanied by fever and shivering, a quick pulse and severe abdominal pain which was worse in the lower abdomen. There was another attack in May 1924. I saw the patient in March 1925 when a tumour could be felt high up in the posterior wall of the rectum. It was thought to be a carcinoma of the dependent loop of the pelvic colon lying in Douglas pouch. It was not adherent either to the uterus or to the sacrum. An operation was advised.

Operation March 25 1925. Left low paramedian incision. Extensive diverticulitis of the pelvic colon with many small stones a little larger than peas in diverticula at the side of the colon. The bowel and its mesentery were shortened from pericolicitis and infiltration. The whole of the pelvic colon the lower part of which was stenosed was excised and end to end union made over a tube. There was no sign of growth. There were numberless diverticula even the descending colon above the resection showed a few small pouches. The patient made a good recovery and was in excellent health six months later.

Resection of pelvic colon for diverticulitis simulating carcinoma Mr E W had suffered during the last year from three attacks of intestinal obstruction each lasting four or five days. Each attack was associated with severe griping pains and abdominal distension. Enemata ultimately brought relief. Radiographic examinations of the colon in the intervals failed either to show the cause of the obstruction or to give evidence of diverticulitis. When I saw him in the last attack the transverse colon was seen to be dilated and contracting violently at intervals. The left iliac colon was in a similar condition. There was no history of melæna. Carcinoma of the pelvic colon was strongly suspected and an operation was performed four days after the obstruction had been overcome by enemata and liquid paraffin. A mass three inches long was found in the lower part of the pelvic colon adherent to the left ureter. It was removed with considerable difficulty owing to the thickening and shortening of its mesentery and the adhesion to the side and back of the pelvis. An end-to-end union was made over a large rubber tube which drained the descending colon through the rectum and anus. The patient made a good and rapid recovery.

After the mass had been removed it was still thought to be a carcinoma but on splitting up the bowel no growth was found only a tight fibrous tubular stricture two and a half inches long due to chronic inflammation around numerous diverticula. It was difficult to introduce the blade of a pair of scissors into the stricture.

In some cases immediate resection with drainage of the bowel above and below, after Mikulicz and Paul's method, has been successfully done. Paul's tubes being tied into the cut ends of the remaining colon. Another operation is generally necessary to re-establish the natural channel,

although this may take place naturally by the sinking in of the colostomy openings.

(c) *Closure of Colico-vesical Fistula.* When a fistula has developed between the colon and the bladder, as a result of diverticulitis of the colon, and the diagnosis of non-malignant disease has been established by means of the cystoscope and X-rays, an attempt may be made to cure this very troublesome and dangerous condition by laparotomy. The sigmoidoscope, which must be used with great care, may reveal the site of adhesions, stricture and perhaps of the fistula. If the lower six inches of the bowel can be proved to be healthy, an operation is hopeful. If the obstruction and fistula are lower, the operation may be very difficult and dangerous. Detachment of the colon from the bladder, with closure of the openings into these viscera, may be performed with the aid of the Trendelenburg position and a good light. The opening into the bladder is fairly easily closed and inverted and, if the disease in the bowel is fortunately localised without stenosis, a similar plan may be adopted for it. If, however, the disease is extensive and causes a definite stricture, and especially if adhesions are dense and extensive, preliminary colostomy with spur formation is indicated. This relieves the distressing pain and cystitis and greatly improves the general condition of the patient. It also makes the subsequent resection of the diseased part of the colon much safer. It is sometimes wise to make the colostomy only a little above the stricture so that it can be removed and the channel of the bowel re-established at the second operation. In some bad cases permanent colostomy is the only safe treatment. The following is an interesting example :

Resection and colostomy for vesico-colic fistula secondary to diverticulitis. Mrs. G., aged 55, had a laparotomy six years before by a gynaecologist for pelvic tumour : a swelling was found which was thought to be carcinoma of the pelvic colon. There was no obstruction at the time, therefore the growth was replaced and the abdomen closed with the idea that a surgeon should remove the growth later, but the wound suppurated and the patient declined to have another operation. Apart from constipation, from which she had suffered for many years, she was comparatively well for the next six years, but in February, 1920, she had signs of inflammation in the lower part of the abdomen and a large swelling formed in the left iliac fossa. There was high fever of the remittent type. An operation was advised, but declined. Three weeks later the abscess apparently ruptured into the bladder, and after this she often passed gas and pus with the urine, and the temperature continued high and remittent. She lost flesh, became anæmic, and at last consented to see a surgeon. I saw her on April 12, 1920, and persuaded her to have an operation. She went into a nursing home, but was so much better for a week that the operation was deferred. However, her temperature went up again and the bladder symptoms continued, so that the operation was performed. Diverticulitis of the colon with fistula in the bladder was diagnosed.

Operation, April 26, 1920. Vertical incision over the lower half of the left rectus. Many dense adhesions in the pelvis between the pelvic colon and bladder. On separating these several abscesses were opened and two cysts, containing sanious fluid, near the left ovary and broad ligament. The left Fallopian tube contained pus and was removed. The fistula into the bladder was found well to the left of the middle line : the opening was closed with catgut and this part was then pushed down in front of the uterus, which was sewn up over it.

The opening on the front of the pelvic colon communicating with the bladder would admit a lead pencil, and its mucous membrane prolapsed and was clearly part of a diverticulum. There was another similar opening lower down and to the right, which was found on trying to separate the lower part of the pelvic colon. The latter was very much shortened, thick, hard and intimately adherent back and front. Its wall was so rigid that it appeared practically impossible to close the openings

mentioned, therefore the diseased part was separated and excised. The disease extended too low to make it possible to join the descending colon to the rectum, therefore the cut end of the rectum was closed and inverted and an end colostomy made at the upper end of the wound.

The specimen removed was about eight inches long, its lumen was considerably narrowed. The openings of many diverticula were found on its mucous surface, many of them hidden by folds of mucous membrane, some extending into fairly large pouches in the fat at the side of the colon.

The patient made a slow but good recovery, the cystitis and shivering ceased at once, but the wound suppurated for some weeks. The restoration of the natural passage was suggested eighteen months later, but the patient preferred to carry on as she was, the colostomy causing her but little inconvenience.

(f) *Treatment of Abscess and Peritonitis* Acute diverticulitis of the colon is best treated conservatively, for it rarely causes diffuse or spreading peritonitis. The patient is placed in the Fowler position and is given nothing by the mouth until the fever has subsided. Saline infusions are given if necessary. If an abscess forms it is opened and drained through an incision above and to the left of the pubes. If the pulse, temperature, pain and abdominal rigidity increase, indicating spreading peritonitis, in spite of treatment, the abdomen is opened and any perforation found is closed, the perforated diverticulum being removed if possible.

STROICAL MORTALITY

Cases of diverticulitis at the Mayo Clinic from January 1, 1907 to January 1, 1924 (Fuld and Pollock):¹

Type of Operation	Number of Patients
Mikulicz	35
Tube resection	12
Resection	21
Colostomy	15
Excision of the diverticulum	15
Drainage of abscess	7
Anastomosis	7
Exploration	6
Total	118

The mortality of these operations was about 10 per cent.

¹ *Loc. supra cit.*

CHAPTER XIX

OPERATIONS ON THE SPLEEN

Splenotomy or incision of the spleen has been successfully performed for cysts and abscess. It is the best treatment when there are very extensive adhesions the separation of which might lead to laceration of the spleen with profuse hæmorrhage. Usually the best incision is one parallel to and one inch below the left costal margin, but drainage may be established posteriorly below the last rib or through the thorax after removal of portions of the ninth and tenth ribs, if possible below the pleural reflexion, or failing this, through the lower part of the pleura, which is often adherent, but if it is not the parietal is sutured to the diaphragmatic pleura before the latter is incised. Belloni and Moschini¹ report a successful case treated in this way. An empyema had to be opened later in spite of the precautions taken to avoid infection of the pleura. Rogers² records the following interesting and rare case :

Amœbic Abscess of the Spleen Cured by Aspiration and Emetine Injections. A native male, aged 32, admitted with enlargement of the spleen to 2 in. below the left costal margin and a tender prominence of the lower ribs, with redness of the skin over it. On exploration, 8 oz. of thick reddish pus and blood, closely resembling that of amœbic liver abscesses, were withdrawn. Three days later there was evidence of refilling of the cavity, so a second aspiration of 4 oz. was performed, and this time 1 grain of emetine hydrobromide in 2 oz. of water was injected. I examined the pus microscopically, and found amœbæ to be present, while it was sterile on culture for bacteria. On each of the next two days half a grain of emetine was injected subcutaneously, but the temperature once more rose, and six days after the second aspiration there was again slight bulging. A third aspiration was now done, but only a little pus and much blood was obtained, and a grain of emetine hydrobromide was again injected into the cavity, and two more $\frac{1}{2}$ -grain doses given subcutaneously. The temperature finally fell to normal two days later, and the abscess did not again refill, but complete recovery ensued.

This case is of great interest, both on account of the rarity of amœbic abscess of the spleen and because of its successful treatment by the new method ; for when opened these abscesses heal very slowly and leave obstinate sinuses. It was for this reason that a repetition of the emetine injection into the cavity was carried out, with the fortunate result recorded.

SPLENECTOMY

It has been known for a very long time that the spleen is not essential to life. It is sometimes absent in animals and also in man without apparent detriment. Small accessory spleens are common and may hypertrophy after splenectomy.³ Sir Berkeley Moynihan,⁴ in his Bradshaw Lecture on the Surgery of the Spleen, goes into this question very thoroughly.

Consequences of Losing the Spleen. There is a temporary increase of white blood corpuscles, especially of lymphocytes, for about a year, and

¹ *Gaz. deg. Osped.*, February 1, 1910.

² *Brit. Med. Journ.*, 1912, August 24, p. 407.

³ W. McAdam Eccles and G. D. Freer, *Brit. Med. Journ.*, 1921, ii, 515.

⁴ *Brit. Journ. Surg.*, 1921, viii, 307.

the eosinophile cells to about 8 per cent for about three years. There is a temporary decrease, for about two months, of the red blood corpuscles, which become more resistant to hæmolytics. There is over action of the lymph glands and bone marrow in blood making, the glands may become enlarged and the bones tender. Splenectomy makes infection a little more likely and is apparently followed by some loss of fertility.

A few remarks upon the history of splenectomy, learnt from Sir Berkeley Moynihan's lecture, may be made here.

Zaccarello, an amateur surgeon, successfully removed the spleen in 1549, and Fioravanti, who helped him, describes the operation.

'I went to see the lady and made preparations with her and with her husband, and having done so went to the Justices to give her up for dead, as is usually done. And, having permission, we went one morning to the lady's house. The good old man took a razor and cut the flesh above the spleen which being cut came out of the body. We went on separating it from the reticulum and took it all out and sewed up the flesh, leaving only a small opening. I dressed it with mixed oil of hypericum, incense powder, mastic, myrrh and sarcocolla, and ordered her a drink of boiled water with ordinary honey, comfrey, betony and holy thistle and every day I made her take a dose of theriac.'

In the seventeenth century, Matthias a surgeon of Colberg removed a spleen which had prolapsed through a wound and Clarke of Somerset, did the same in 1676. The latter performed the first experimental splenectomy on a dog, the animal recovered. In 1669, Malpighi ligatured the splenic artery in a dog, which resulted in almost complete atrophy of the gland.

The first splenectomy deliberately performed in England (the fifth in the history of the operation), for an enlargement of the organ, is related by Spencer Wells. The patient was a married woman, thirty four years of age, who was "evidently dying from a large spleen," and who had no other disease. The patient died of septicæmia about six months after the operation.

Thomas Bryant performed the operation twice for leukæmia at Guy's Hospital in 1866 and 1867. Both patients died from hæmorrhage, and Bryant comments as follows.

"We have learnt two things from the cases related. Firstly, that enlargement of the spleen in leucocythæmia appears to be only a part of a general disease affecting the glandular system as a whole, and, secondly, that in splenectomy for such a disease there is a predisposition to hæmorrhage with which surgery is incompetent to deal. It can neither be foreseen by any amount of care nor coped with by any amount of skill. Under these circumstances there is no shirking the conclusion that the operation is physiologically unsound and surgically unsafe, and, for leucocythæmia, should not be performed."

Indications for Splenectomy. 1 **Rupture.** The spleen may be ruptured from injuries, with or without wounds, and the resulting hæmorrhage is frequently swiftly fatal. In some cases suture of the spleen or packing the wound with gauze has arrested the bleeding and saved life, but as a rule the best course is to remove the spleen at once. Directly the abdomen is opened the hand is passed through the enormous amount of blood, which is often present, to seek and hold the pedicle, which is then clamped and ligatured.

The spleen may also rupture and need removal in malaria and enteric fever. It sometimes ruptures spontaneously, or after slight injury in these and other conditions.¹ As to the diagnosis of ruptured spleen the following points are of value :

- (a) The locality of the injury.
- (b) The evidence of internal hæmorrhage.
- (c) Abdominal rigidity and marked increase of fixed splenic dulness.
- (d) The evidence of an increasing collection of fluid in the abdomen

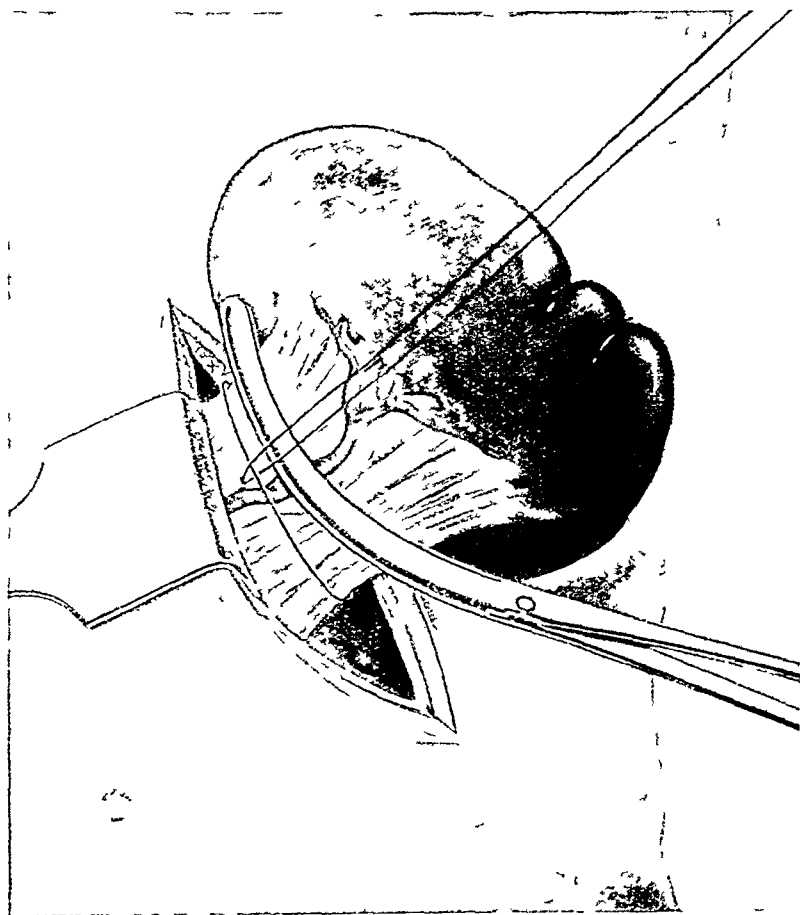


FIG 232 Splenectomy. The pedicle is clamped and the ligature placed ready for tying.

and of the fact that, while the dulness in the right flank can be made to disappear by change of position, that in the left flank remains constant.

The operation should be performed as soon as the diagnosis is made, for to wait for reaction from shock and collapse is to wait for more hæmorrhage and to throw away the fair chance the patient has of recovery from early operation. When the bleeding is not severe enough to cause death within a few days the blood clot may become infected from the bowel, causing localised or diffuse peritonitis. The peritoneal sac should be

¹ J. F. Connors, *Ann. Surg.*, 1921, LXXIII, 1, and W. E. Leighton, *ibid*, p 13.

rapidly cleansed from all blood and clots. Every precaution for meeting shock should be taken before, during and after operation. Blood transfusion is often of inestimable value, and in some cases the blood in the peritoneal cavity can be citrated and used for auto transfusion with satisfactory results and with less reaction than when blood is transfused from another person, however well chosen.¹

In 1911 a boy, aged 17, came under my care who had run against the posterior edge of a hand cart, striking his abdomen and left lower ribs. After sitting down in pain for fifteen minutes he was able to walk about a mile, and five hours later he came to Guy's Hospital. He walked to and from the tramcar. He was rather pale on admission, with a rising pulse of 110 to 120. His abdomen was quite rigid and very tender. It was also becoming fuller and its resonance was becoming impaired in the left flank and left iliac region. As the diagnosis was uncertain between laceration of the jejunum and ruptured spleen a vertical incision was made through the left rectus. A large amount of clot and blood at once escaped and a rupture of the spleen was felt. The relief of intra abdominal tension seemed to increase the bleeding, which was furious until the pedicle was secured with a strong clamp (Fig. 232). Although the wound was long it was impossible to get proper access to the spleen, which was high and adherent until another incision was carried downwards and outwards from the upper end of the vertical one. The rent was a large antero-posterior one almost dividing the organ and extending into the hilum so that suture was hopeless. Moreover, the spleen was very friable. The pedicle was transfixed in front of the clamp and tied with a Staffordshire knot of strong catgut. Meanwhile the patient was being infused into the axilla: five pints were given during and soon after the operation. There was much blood in the abdomen especially in the pelvis, which was rapidly cleaned out. The patient made a good recovery and was able to leave the hospital in three weeks.

Prognosis. Without operation perforation or laceration of the spleen is almost certain to end fatally. With early operation (usually splenectomy) about 70 per cent. may be expected to recover.

(2) **Wandering Spleen with twisted Pedicle.** A movable spleen may be a cause of pain and disability when the pedicle becomes twisted, and an operation—either splenopexy or splenectomy—has to be performed. The latter is generally chosen and, as a rule, proves easy and successful in these cases.

(3) **Cysts**—hydatid, blood,² serous, lymphatic and dermoid. As a rule splenectomy is indicated for these conditions, but it may be a difficult operation owing to adhesions. Sometimes a slight injury may induce bleeding into or cause a splenic cyst. A spleen of this kind was shown at the Medical Society of London in 1922 by Mr Gwynne Williams. A young man had been hit in the epigastrium by a football and subsequently developed symptoms of left sub diaphragmatic abscess for which an operation was undertaken. The real condition was discovered at the operation, which was successful.

(4) **Splenic anaemia, including von Jaksch's (infantile) Disease.** Splenectomy is the only satisfactory treatment for splenic anaemia, and it should be done early before perisplenitis develops, with resulting adhesions, which add greatly to the risk of delayed operations. It should also be carried out before severe secondary changes (cirrhosis) take place in the liver and ascites develops. In these later stages splenic anaemia is commonly called "Banti's disease." As I have said, the operation in the

¹ H. Haulke, *Beitr. z. Klin. Chir.*, 1921, cxxii, 389.

² R. H. Fowler, *Ann. of Surg.*, 1921, lxxiii, 20.

³ C. S. Hamilton and E. H. Boyer, *Ann. of Surg.*, 1921, lxxiii, 58.

later cases may be extremely difficult, owing to extensive adhesions and also the size of the spleen. On this account it has had to be abandoned in some cases. Out of ninety-three splenectomies performed at the Mayo Clinic¹ there was a mortality of 10·8 per cent. There appears to be a special liability to infection in cases of splenic anæmia and also to thrombosis in the splenic vein spreading to the superior mesenteric or portal vein, sometimes causing death from gangrene of the intestine.

It is interesting to note that after operation the liability to severe hæmorrhage (especially hæmatemesis, which is characteristic of splenic anæmia) is not entirely eradicated, for the bleeding may recur and even terminate fatally as many as seven years later. This happened in the case of a young man, a patient of Dr. A. F. Hurst and the late Sir William Osler, whose spleen I removed in 1915. He was in excellent health and his blood in good condition until sudden hæmorrhages occurred, apparently into his brain and stomach, and he died. Hæmorrhages recurred, often after long periods, in ten of the cases of splenectomy for this disease at the Mayo Clinic.² It is due to secondary cirrhosis of the liver.

The splenic anæmia of infants (von Jaksch's disease) is more favourable and recovery often follows good feeding, but splenectomy is necessary in some cases. There were eight splenectomies performed at the Mayo Clinic³ without a death.

(5) **Egyptian Splenomegaly.** This is a common disease characterised by progressive cirrhosis of the liver, enlargement of the spleen and secondary anæmia. It resembles Banti's disease, but it is associated with fever and is probably due to an infection; the cirrhosis is an essential part of the disease from the beginning. It is incurable by medical treatment, but splenectomy is indicated and hopeful if undertaken before ascites develops. Owen Richards and Day⁴ discuss this disease in an able paper, and later Richards⁵ reports 22 splenectomies with four deaths. He also describes the operation he adopts in these difficult cases.

(6) **Hæmolytic Jaundice.** This is a condition of anæmia with slight jaundice of the acholuric type—that is, there is no bile pigment in the urine and the fæces are not pale, but there is marked fragility of the red blood corpuscles. There are at least two varieties, the acquired and the familial, in which several members of the family may be affected.

The acquired form is by far the more serious, and without operation is practically always fatal. In this condition splenectomy is most successful, being easy and attended with a low mortality. The Mayo Clinic⁶ publishes a record of 49 operations, with a mortality of 4 per cent. There have been many successful cases at Guy's Hospital. The jaundice clears up in a few days, but the fragility of the blood corpuscles may remain for many years. Lord Dawson recently reported a case where the fragility persisted for thirty years after a successful splenectomy by Sir Spencer Wells. It is interesting that in more than half of these cases biliary colic

¹ W. J. Mayo, *Collected Papers of the Mayo Clinic*, 1923, xv, 770.

² *Loc. supra cit.*

³ *Loc. supra cit.*

⁴ O. Richards and H. B. Day, *Trans. Soc. Trop. Med. and Hygiene*, July, 1912, No. 8, p. 333.

⁵ O. Richards, *Brit. Journ. Surg.*, 1914, i, 419.

⁶ *Loc. supra cit.*

and gall stones were present, and in some an operation for the removal of gall stones had naturally not cured the jaundice. Either at the time of the splenectomy or, better still, subsequently, the gall stones may have to be removed and the gall bladder drained. It is not wise to operate during one of the crises so characteristic of this disease.

Operation is not so often indicated for the less severe famulal type.

(7) **Syphilitic Splenomegaly.** Late syphilis, especially the congenital variety associated with great enlargement of the spleen, fails to respond to thorough and prolonged medical treatment. Under these circumstances splenectomy may immediately relieve the patient, for these spleens contain gummata and harbour spirochaetes which are not amenable to medical treatment. The Wassermann reaction becomes negative and the gummatus liver soon shrinks to the normal size, the anaemia disappears. Many successful cases of this kind are mentioned by W. J. Mayo.

(8) **Tuberculosis of the Spleen.** Occasionally tuberculosis may be limited to the spleen and splenectomy indicated. It proved successful in four out of six cases operated on at the Mayo Clinic,¹ one of the two deaths occurred two months after the operation and was due to general miliary tuberculosis.

(9) **Pernicious Anaemia.** It is still uncertain whether splenectomy is worth while in Addison's or pernicious anaemia. It has been performed more on the Continent and in America than in England and was first suggested by Eppinger. At the Mayo Clinic there were three deaths in 59 cases.² Giffin and Szlapka³ investigated 50 splenectomised patients and "the pessimism which existed in the Clinic has been partly dispelled at least. It was found that 21.3 per cent of the patients with pernicious anaemia survived the operation three years or more, living two and one half times as long as the average in a similar group of non splenectomised patients at the same stage of the disease, and that 10.6 per cent are alive after more than five years. This clearly indicates in at least one third of the cases that the average life of patients with pernicious anaemia is greatly prolonged and in about 10 per cent the prolongation is sufficient to lead to the hope that cures may result in some cases."

Before splenectomy is considered every endeavour is made to improve the condition of the patient and the quality of his blood by the removal of all sources of sepsis, oral, appendical and sometimes biliary, by the free administration of hydrochloric acid (for all these patients have achlorhydria), and by step ladder transfusions of blood. After trying these methods thoroughly, without lasting benefit, I performed splenectomy in two grave cases for Dr. A. F. Hurst, with very striking advantage to the patients, whose blood and general condition improved immensely. Some six months later, however, one of these patients died of influenzal pneumonia.

(10) **Myelogenous Leukaemia.** This disease showed a mortality of 3.8 per cent in 26 splenectomies performed at the Mayo Clinic.⁴ The operations were not undertaken until the enlargement of the spleen had been greatly reduced by radium therapy. Some of the patients greatly

¹ *Loc. supra cit.*

² *Loc. supra cit.*

³ W. J. Mayo, *Collected Papers of the Mayo Clinic*, 1921, xiii, 619.

⁴ H. Z. Giffin, *Collected Papers of the Mayo Clinic*, 1920, xii, 526.

improved after the operation, which, W. J. Mayo¹ thinks, is worth while if performed early in the disease; also in the more chronic types.

(11) **Gaucher's Disease (Endothelioma of the Spleen).** Splenectomy is the only hopeful treatment for this rare condition. It was performed on four cases at the Mayo Clinic,² with two deaths.

(12) **Malarial Splenomegaly.** The medical treatment of malaria has improved so much that splenectomy is very rarely necessary, apart from rupture. The operation was attended by a high mortality.

Other indications for splenectomy are septic spleen, abscess of the spleen and aneurysm of the splenic artery. It has been successful in one case of polycythemia rubra vera and in two cases of hæmorrhagic purpura.³ It has been performed for splenomegaly due to bilharzia and kala-azar, also for lymphadenoma (Hodgkins' disease) and lympho-sarcoma, but there is no proof that the operation has done any permanent good in these conditions.

Operation. Every care must be taken before, during and after the operation to prevent hæmorrhage, shock and sepsis.

The table is tilted a little to the right and the surgeon stands on this side, for this makes it easier to separate and deliver the spleen. A left, long paramedian incision, extending from the left costal angle well below the umbilicus, is the one most generally useful. If more room is required above, the left costal margin can be retracted after dividing the seventh and eighth costal cartilages below the pleura. This incision gives the best access to the pedicle, it facilitates the general exploration, and it allows any necessary treatment of the biliary apparatus or the appendix; in cases of rupture or wounds of the spleen it enables the surgeon to find and treat any associated injuries, which are not uncommon. When the spleen is very adherent to the left flank and diaphragm, as it often is in late cases of splenic anæmia and Egyptian splenomegaly, an incision further out (either vertical or parallel to the costal margin) makes it easier to deal with adhesions. For similar reasons Vanverts removed portions of the 8th, 9th and 10th costal cartilages subpleurally.

The peritoneum is opened freely and the abdomen is explored, special attention being paid to the liver and its ducts. The spleen is examined, and if at this stage the surgeon is satisfied that the adhesions between a very large spleen and the diaphragm are too extensive and intimate, he will do well to close the wound,⁴ especially if there is marked cirrhosis of the liver. If, however, it is decided that the spleen can be removed without undue risk, the hand gently but rapidly separates any adhesions to the diaphragm, care being taken to avoid injuring the latter and perforating the pleura or pericardium—accidents which have happened during difficult splenectomies. Any bleeding points are tied or over-sewn with cat-gut. The right hand is passed above and to the left of the spleen to bring the latter downwards and forwards into the wound; meanwhile the assistant places a large moist gauze roll in the space behind the spleen. The end of the gauze roll is fixed outside the wound so that it cannot be

¹ W. J. Mayo, *Collected Papers of the Mayo Clinic*, 1923, xv, 770.

² H. Z. Giffin, *loc. supra cit.*

³ W. J. Mayo, *loc. supra cit.*

⁴ P. Lombard recommends the intracapsular removal of such an adherent spleen (*Bull. et Mem. de la Soc. de Chir.*, 1921, xlvii, 826).

lost. Any adherent omentum is separated and tied if necessary, and the vascular connections between the spleen and the stomach are tied and divided care being taken to avoid injuring the stomach which has been accidentally opened during this operation with unfortunate results. The spleen is very gently delivered out of the wound which should be of adequate size for any jerking or sudden force may lead to laceration of the thin walled veins of the pedicle. It is turned over to the right to display the pedicle better and the tail of the pancreas (often visible behind) is separated. The Balfour technic is then followed¹ (Fig. 233).

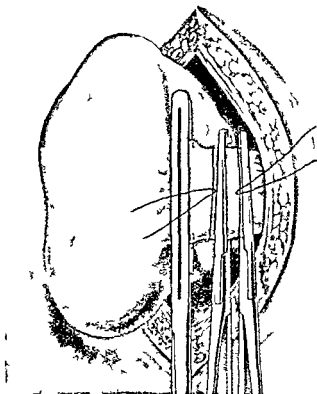


FIG. 233 Splenectomy. The spleen has been turned over to the right its pedicle clamped and ligatures placed ready for tying in the grooves left as the two smaller forceps are removed.

The splenic pedicle is then grasped in such a manner as to compress the artery between the thumb and the finger and is held during a few heart-beats in order to allow the venous blood to drain from the spleen back into the general circulation. Two forceps are then placed on the proximal side and one next the spleen and the pedicle is divided. A catgut tie is made in the groove of the deeper forceps as they are removed and a second tie in the groove of the second forceps as they are removed. With fine catgut on a needle the separated peritoneal tissues and other loose tissues along the upper surface of the pancreas are drawn together and some small bleeding vessels in that situation are secured.

¹ W. J. Mayo, *Collected Papers of the Mayo Clinic*, 1901, x, 631.

In some cases the pedicle is too short and wide for this plan to be adopted. If so, the vessels are isolated, tied separately and divided between proximal and distal ligatures, as recommended by Owen Richards for the very large spleen of Egyptian splenomegaly. Pedicle clamps are very valuable to stop the furious bleeding from a ruptured spleen; then the vessels can be seen more easily and tied at leisure. It is important:

- (1) To prevent any tension on the pedicle.
- (2) To secure every vessel.
- (3) To divide these in a relaxed condition at a sufficient distance from the ligatures.
- (4) To avoid torsion of the pedicle. Sir Spencer Wells ruptured the splenic vein in doing this, in endeavouring to bring the vessels into a cord for easy ligation.

All bleeding is carefully arrested and the abdomen is completely closed, for drainage is unnecessary and encourages secondary infection.

Causes of Death. Hæmorrhage is by far the most common. It may be from a laceration before the operation, from the omentum adherent over the spleen, from the large vessels to this viscus, from some small vessel that has retracted, from the splenic vein or from sponge-like adhesions. In these cases of sudden loss of large amounts of blood axillary infusions may not be absorbed with sufficient rapidity, therefore intravenous infusion of gum solution is strongly indicated. Blood transfusion is resorted to as soon as possible.

Mr. Hatch, of Bombay,¹ met with a case in which death took place a few hours after the splenectomy, owing to oozing from some adhesions between the spleen and the diaphragm, which had required separation. The pedicle was safely secured. In another case² death, twenty-four hours after the operation, was due to bleeding from the abdominal incision, owing to defective coagulation of leukæmic blood. The ligature on the pedicle was firm.

Other causes of death are subdiaphragmatic abscess, pulmonary complications and thrombosis of the superior mesenteric vein with symptoms of acute intestinal obstruction. The clotting spreads from the splenic vein, whose wall is often diseased.

SPLENOPEXY OR FIXATION OF A WANDERING SPLEEN

This is an operation which is rarely required, for undue mobility of the spleen is usually only a part of Glenard's disease, when it can be best treated by means of abdominal supports. In other cases the mobility is due to an increase of size, due to organic disease, which may or may not require operative treatment. In some cases, however, a wandering spleen may cause pain, sickness, and faintness, and may prevent the patient from leading an active life. When a good belt has been well tried and has failed to afford relief, an operation may be suggested.

In suitable cases without any disease of the spleen, but only undue mobility, splenopexy should be preferred to splenectomy, and it ought to be more free of immediate danger and of possible changes in nutrition.

Operation has only been adopted in a few cases so far, and in these a different method has been invented for almost every patient.

¹ *Lancet*, 1889, ii, 1053.

² *Centr. f. Chir.*, July 18, 1885.

The late Mr J Basil Hall has contributed an interesting article upon the subject,¹ and he has recorded a case of his own in which he used an ingenious method. He collected nine cases, including his own, with no deaths. The following are some of the methods that have been employed.

In 1895 Kouwer (quoted by Basil Hall) used a lumbar incision and induced the formation of adhesions by means of tampons placed around it. This proved successful in one case, the spleen being well fixed four years later. The tampons had to be removed from another patient because they produced symptoms of intestinal obstruction.

Rydygier, in 1895 made a pouch for the spleen between the parietal peritoneum and the diaphragm upon the lateral wall of the splenic fossa, this he performed through a median abdominal incision.

Tuffier, Giordano, and Greiffenhagen have passed sutures through the parenchyma of the spleen and the parietes, severe hæmorrhage followed in Greiffenhagen's case. The spleen is so friable that all suture methods are to be condemned.

Bardenhauer made a vertical incision in the left flank, and separated the peritoneum from the parietes. He then brought the spleen out through a small opening in the peritoneum. This opening was narrowed round the pedicle so that the spleen was retained in the subperitoneal tissues, and the wound closed over it.

Basil Hall fixed only the lower part of the viscus in the wound by narrowing the peritoneal incision and posterior rectus sheath so that the edges gripped the spleen at the narrow isthmus formed by a deep notch upon the anterior border near the lower pole. He also promoted the formation of adhesions by rubbing the peritoneum of the splenic fossa. The rectus muscle was brought over the prolapsed part, and the wound closed. The patient was completely relieved.

¹ *Ann of Surg* 1903, xxxvii, 481

CHAPTER XX

OPERATIONS ON THE LIVER

INJURIES, HYDATIDS, HEPATIC ABSCESS, REMOVAL OF GROWTHS OF THE LIVER

OPERATIONS FOR INJURIES

THE liver is subject to two chief kinds of injuries, (*a*) perforating wounds such as stabs and gunshot wounds (*see* Chapter XIII.), and (*b*) subcutaneous laceration from crushing injuries. As a rule injuries of the liver are very serious on account of the rapid and severe hæmorrhage associated with them and the other injuries so frequently complicating them.

Indications for Operation. When, after an injury in this neighbourhood, signs of internal hæmorrhage with collapse, abdominal rigidity and

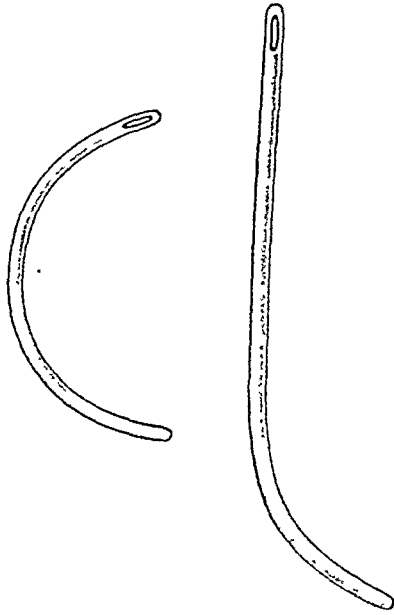


FIG. 234. Kousnetzoff's needles for liver suture; they are blunt and flexible.

dulness in the right flank appear, an operation should be undertaken, but when the symptoms are not severe it is often wise to watch and wait, because spontaneous cure is common after slight laceration of the liver. As a rule it is better to open the abdomen in front so that a thorough exploration can be carried out. Kocher's incision commonly made for exposing the gall-bladder serves well. In some cases, however, there may be some difficulty in reaching wounds upon the posterior and right surface of the liver, and in these cases it may be necessary to make an

incision through the thorax either behind or at the side if possible below the pleura by removing portions of the lower ribs or rib cartilages or failing this through the pleura after sewing the parietal and diaphragmatic surfaces together before incising them. Often the need of an additional incision can be avoided by dividing the suspensory the coronary or right lateral ligament and thus mobilising the liver as far as possible. Towards the end of the operation the ligaments can be sewn up again. Directly the abdomen is opened the liver is examined and a laceration having been found hæmorrhage is checked by placing a soft bladed intestinal clamp on the lesser omentum at the foramen of Winslow and thus

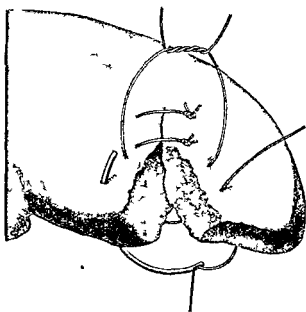


FIG 235 Suture of wound of left lobe of liver with stout catgut passed by blunt ended round bodied needles. Large vessels are tied on the cut surface of the liver

securing the portal vein and hepatic artery while the laceration in the liver is rapidly closed by sutures which should be introduced with blunt round supple needles that do not pierce or lacerate the vessels. Stout catgut is the best material to use for thin sutures cut through the friable liver and thin walled blood vessels. The stitches should be interrupted about one third of an inch apart and passed so that they entirely surround the wound. When the latter is near the free border the suture should pierce the whole thickness of the liver about one third of an inch away from the edge of the laceration. The stitches are tied slowly but firmly. Occasionally a large vessel may be seen upon the cut surface and this may be held with forceps and tied separately. Some wounds which from their position and extent do not lend themselves to suture should be packed with gauze or omentum but a few sutures should be passed

if possible to keep the flaps together. When the sewing has been completed the clamp upon the vessels is removed, and if any hæmorrhage occurs some more stitches should be inserted to control it. The clamp is very useful in controlling hæmorrhage and in enabling the surgeon to do quicker and more effective work ; but it must not be left on a moment longer than is necessary on account of the congestion of the intestines, which obstruction of the portal veins produces. J. H. Pringle¹ found that total occlusion of the portal vein for one hour did no harm. McDill² introduces an intestinal clamp through a puncture in the abdominal wall below the right costal margin in the axillary line. The blades are guided into position with the left hand in the anterior wound. It is safe to leave the clamp on the vessels for at least ten minutes at a time. The vessels may be controlled by the fingers and thumb of an assistant. When the bleeding has been stopped the abdomen may be completely closed, but when oozing continues or a gauze pack has been used, the upper part of the wound is left open for drainage for a few days. It is not wise to remove the gauze for at least five days, otherwise bleeding may recur.

OPERATIONS FOR HYDATIDS

Incision, enucleation and excision will be described ; the milder measures of puncture and electrolysis proved successful in some cases, but we do not know for certain how the death of the parasite was brought about by them in successful cases. At the present time these uncertain methods have been rightly abandoned, although they were useful in pre-antiseptic days, when they were much safer than the more radical procedures. For multiple cysts, however, irrigations of Formalin (1 per cent. solution) may be tried with the object of killing the parasites. The surroundings of hydatids of the liver are of truly vital importance, and sudden death has followed tapping more than once. Thus, in Mr. Bryant's case,³ while a hydatid cyst was being tapped, the portal vein, which had been pushed upwards and forwards by the projection of the cyst on the under-surface of the liver, was transfixed. Death followed in five minutes, and was thought by Dr. Fagge to be due to hydatid fluid being sucked into the vein as the trocar was withdrawn.

In a Russian case⁴ the pulse suddenly stopped while the cyst, which had been exposed by abdominal section, was being stitched to the incision. At the necropsy, a crumpled echinococcus had made its way into the right auricle, and a fragment of one into the right division of the pulmonary artery, by an opening between the thinned cyst and the inferior vena cava. Mr. Willett⁵ mentioned a case in which he had to aspirate a doubtful swelling of the liver. He used an ordinary-sized needle, and within two minutes the patient was dead. It turned out to be a case of malignant disease. No large vein had been pricked, and there was no hæmorrhage. The sudden, fatal syncope seemed due to the impression made on the nervous system through the solar plexus. Several other deaths from syncope have been recorded. Peritonitis, empyema or sub-diaphragmatic abscess may arise from leakage at the point of puncture

¹ *Ann. of Surg.*, October, 1908.

² *Journ. Amer. Med. Assoc.*, 1912, ii, 1283.

³ *Clin. Soc. Trans.*, 1878, xi, 230.

⁴ *Lond. Med. Record*, 1885, p. 414.

⁵ *Brit. Med. Journ.*, November 13, 1886.

after the withdrawal of the needle or trocar Hydatid infection of these regions may also occur from the same cause Suppuration in the sac occasionally took place even after taking all precautions against infection from the instruments employed

(1) **Laparotomy.** A large majority of cases can be satisfactorily dealt with by laparotomy Kocher's incision gives the best view and access

(a) *Incision Enucleation of the Endocyst and Drainage Indications* When suppuration has occurred within or around the sac, when the latter is calcareous and adherent to vital structures, when it is important to complete the operation without delay on account of pulmonary complications, or when it is impossible to remove the disease completely It may be carried out in one or two stages, but it is generally better to complete the operation at one sitting

The abdomen having been opened and rapidly explored with the hand passed in all directions, especially along the upper surface of the liver and into the pelvis the liver around the cyst is accurately sewn to the parietal peritoneum and the edges of the wound are protected with enveloping pads These are important steps necessary to prevent grafting of hydatid and septic infection

The needle of an aspirator or a fine trocar is then thrust into the front of the swelling in the liver and the existence of fluid beneath thus verified and evacuated as far as possible As the needle is withdrawn the liver is incised and a finger quickly plugs and then enlarges to an inch and a half, the opening made by the knife Any scolices which are within reach are next removed and, if the patient's condition is good the contents and all the wall of the true cyst cleared out with the aid of sponge holders and forceps This method was first introduced by Mr Knowsley Thornton¹ and is based on the fact that the endocyst can nearly always be separated from the ectocyst without difficulty or hæmorrhage and this ensures a radical cure A large drainage tube is then inserted and the usual gauze dressings applied

(b) *Enucleation of the Endocyst with Occlusion of the Cavity of the Ectocyst* The whole endocyst is enucleated from the ectocyst and the liver, the cavity in the latter is then obliterated as far as possible by means of catgut sutures, and the hepatic and abdominal incisions are sutured with only temporary drainage This operation is not suitable for suppurating cysts, but in other cases it is very successful, although suppuration has occurred in the infolded cysts in some cases, requiring secondary drainage

(c) *Excision of the Whole Cyst* Pedunculated or small superficial hydatid cysts originating in the liver have been completely excised The writer successfully excised one, the size of a foetal head from the inferior surface of the liver, hæmorrhage was arrested by careful sewing with catgut

Operation in Two Stages. The abdomen is opened and explored as described above To make certain of the position of the fluid, a fine trocar may now be thrust into the prominent part of the liver If the cyst be crammed with scolices, very little fluid escapes, if it be an acephalocyst, the fluid may spurt out under the high pressure not infrequently

¹ *Med Times and Gazette*, 1883, 1, 80

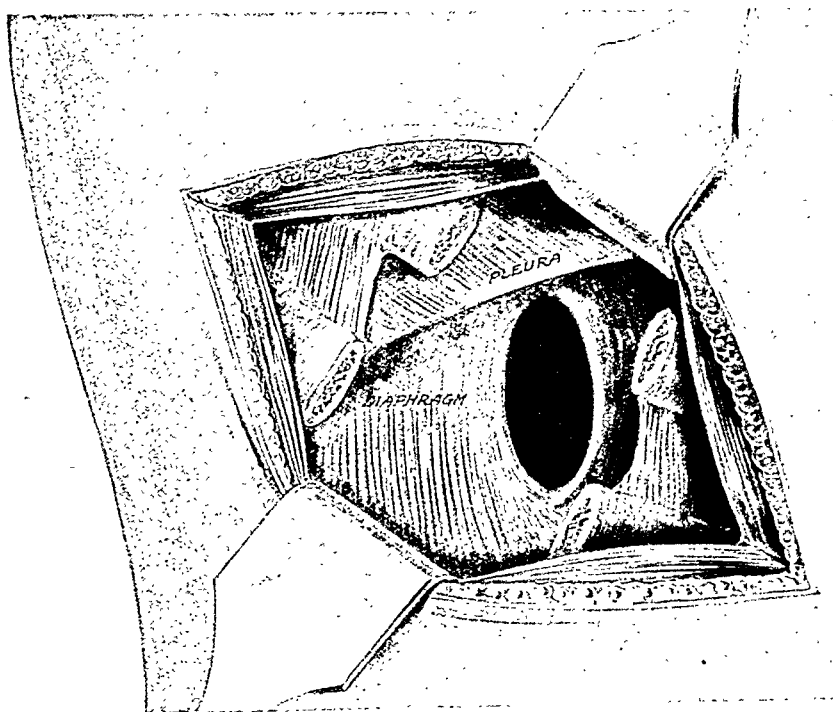


FIG. 236.—Subpleural exposure of cyst or abscess of liver.

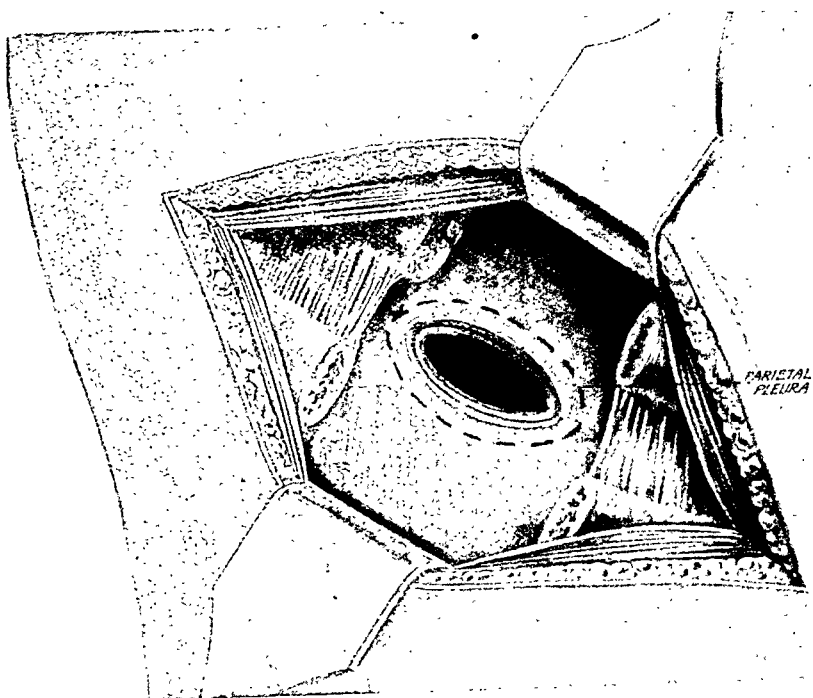


FIG. 237.—Transpleural exposure of cyst or abscess of liver.

met with. After a few ounces have been withdrawn, any leaking is stopped by sponge pressure or suture. The parietal peritoneum is stitched to the liver, the wound plugged with strips of gauze and the dressings firmly applied. On the third day the operation is completed by incising the liver, now well adherent and inserting a large drainage tube. The method is rarely used except when suppuration has taken place in the cyst.

(2) **The Thoracic Route.** The thoracic route is the best when the cyst is placed upon or near the convex upper surface of the liver or bulging

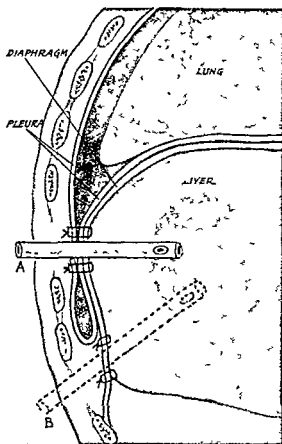


FIG. 238.—Transpleural (A) and subpleural (B) drainage of hepatic cyst or abscess

the chest wall well above the costal margin. Whenever possible the cyst is approached and drained below the pleural reflexion (Fig. 236) but when the cyst is too high for easy access and drainage in this way the transpleural route is adopted. If the pleura is not adherent, the parietal and diaphragmatic layers are sewn together in an elliptical manner before the pleura and diaphragm are incised (Fig. 237). This step is essential in order to prevent pneumothorax or pleural infection. Similarly, the diaphragm may be sewn to the liver before the latter is incised, so that leakage may not occur into the peritoneal cavity (see Fig. 238).

The operation may be completed either in one or two stages, as described above, the endocyst being enucleated and the ectocyst being either drained or obliterated as may appear the best plan.

Results. The results of timely and careful operations for hydatid of the liver are good. There need be few deaths except in neglected or late cases with extensive disease, multiple or suppurating cysts. Recurrence of the disease may follow incomplete removal or from infection during operation.

OPERATIONS FOR HEPATIC ABSCESS

Tropical abscess of the liver is usually amœbic in origin. Rogers¹ found a history of dysentery in 90 per cent. of undoubted liver abscesses. Eighty per cent. are sterile when opened, but later micrococci invade the majority and contribute seriously to the mortality, which has been estimated at 60 per cent. Therefore it is clearly most important to do everything possible to avoid secondary infection during and after operation. In the majority of cases tropical abscess is solitary and is situated in the right lobe in 85 per cent.,² mostly at the upper and posterior part. Solitary abscess is sometimes found in patients who have never been abroad, generally due to infection from the intestines, which may be ulcerated. Unfortunately septic or pyæmic abscesses are usually multiple. In suppurative pyelphlebitis numberless small abscesses form so that the condition is beyond surgery.

The most important signs are irregular fever, profuse sweating, severe pain and local tenderness over the liver, increased liver dulness with diminished mobility and perhaps enlargement of the right side of the chest and pulmonary complications on the right side, and leucocytosis with increase of the polymorphonuclear cells. Radiographic screen examinations are of the greatest value in diagnosis.

Rogers³ has shown that ipecacuanha in large doses, and especially emetine given hypodermically, frequently cures amœbic hepatitis before or even after the onset of suppuration. This treatment should always be tried before advising operation. Emetine hydrochloride can be injected intramuscularly in gr. 1 doses daily without inducing vomiting. This is a discovery of the greatest importance. I venture to quote Sir Leonard Rogers as follows :

“Principle of Treatment of a Protozoal Produced Abscess. The proof that tropical abscess of the liver is caused originally by a protozoal organism, and is, in the vast majority of cases, free from staphylococci and bacteria, at once suggests that the best method of treating it may differ widely from that universally adopted in the case of ordinary septic collections of pus. This principle has already been widely adopted in the case of large cold tuberculous abscesses, which are not usually drained by the open method, but are commonly emptied by the aspirator and iodoform or other tubercle germ-destroying substance injected into the cavity. On similar lines I have already described⁴ the success in certain cases of aspiration and injection of quinine (which kills the causative amœba) for tropical liver abscess.

¹ *Brit. Med. Journ.*, October 24, 1908.

² R. Havelock Charles, *ibid.*

³ *Brit. Med. Journ.*, June 22, 1912, p. 1424.

⁴ *Ibid.*, June 16, 1906.

"The Technique of Aspiration" The ordinary straight stiff aspiration cannula cannot be left in the cavity of a liver abscess for the purpose of repeated irrigation. It however occurred to me that if it could be made of flexible silver tubing such as an inner tracheotomy tube it might safely be left in and used for siphon drainage and irrigation being connected by a long piece of rubber tubing with a vessel containing some non toxic antiseptic so that no air can enter the abscess cavity. Last year when in England Messrs Down Brothers kindly carried out this idea for me in a very successful manner. The sheath is so flexible that it can quite safely be left in after withdrawal of the trocar and will accommodate itself to any altered relationship of the parts traversed due to shrinkage of the abscess cavity. The space between the tubes in the

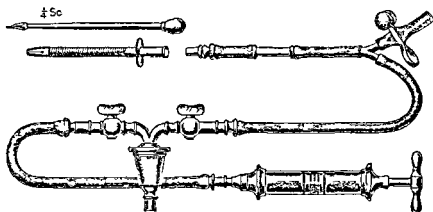


FIG 239 Rogers flexible tube and aspirator for draining hepatic abscess

handle are connected by a piece of thick walled pressure rubber tubing which is clamped as the trocar is withdrawn to prevent any entry of air while it is being connected with the aspirator or with the antiseptic containing vessel under the bed for siphon drainage. A piece of silver Y tubing is also provided to allow of washing out with quinine solutions the soluble bihydrochloride in a strength of 3 to 5 grains to the ounce being used the weaker strength for large abscesses and the stronger for small ones so as to limit the total quantity of the drug left in the cavity (see Fig 239).

By this means after aspirating the pus from the cavity a few ounces of the quinine solution not containing more than thirty grains of the salt are injected into the cavity by means of a glass syringe and left there. A dressing is applied over the wound around the tube. If the abscess is a small one siphon drainage may not be necessary and in any case it can be stopped at night by clamping the exit tube to allow of the patient changing his position if this is thought to be advisable. On the following day the aspirator is again connected up and any accumulation of pus removed after which the quinine solution is run in through the other limb of the Y tube most simply through a funnel covered with aseptic gauze to prevent dust falling in care being taken that it is not allowed to completely empty itself so that no air can enter. Suction may be again applied and the cavity thus washed out with the sterilised quinine

solution, some being always finally left in. Daily irrigations should rapidly lessen the quantity and thickness of the discharge, just as happens in the open method when the wound remains sterile and quinine injections are used, so that in small or medium-sized abscesses, when the discharge or material removed by aspiration is reduced to a little thin serous matter free from amoebæ and bacteria, the tube may be removed, and the cavity and any sinus in its track should rapidly heal under aseptic dressings."

Rogers¹ recorded interesting cases illustrating his methods of treatment by simple aspiration and emetine injection into the abscess cavity and subcutaneously. Ultimately he proved that aspiration and intramuscular injection of emetine sufficed in most cases of uncomplicated amoebic abscess.

In his Lettsomian Lectures, delivered in 1922, Sir Leonard Rogers² confirmed his opinions and showed that the mortality of liver abscess had been reduced from 56 to 14 per cent. by the introduction of the treatment by aspiration and emetine injections.

A. I. Ludlow³ and A. R. Neligan,⁴ from their extensive experience, strongly recommend this method. Emetine alone cures many early cases.

ASPIRATION AND SIPHON DRAINAGE

The late Sir James Cantlie from his great experience strongly recommended this method, which is safer than an open operation. It calls for less operative skill and can be adopted with comparative safety under circumstances which are unfavourable for a major operation. For these reasons it can be applied without the delay that is otherwise unavoidable. The medical attendant often alone in a remote tropical region may shrink from submitting the patient to a difficult operation, or from performing it himself under adverse circumstances. On the other hand, much time is wasted before the patient can be moved to an operating centre. The method is particularly suitable for deep-seated abscesses, especially in the suprahepatic region, for in this way these abscesses can be found and evacuated early, and long before they assume a great size at the expense of the liver tissue and general health, and before they bulge or burrow to the surface.

Operation. As soon as an hepatic abscess is strongly suspected and emetine injections have failed, the liver is explored as already described and, if possible, under an anæsthetic, so that this can be thoroughly done. Failing a general anæsthetic morphia gr. $\frac{1}{3}$ and scopolamine gr. $\frac{1}{100}$ should be injected an hour before the exploration and novocaine used locally. In all cases the surgeon must be prepared to evacuate the pus at once, otherwise the contents of the abscess, often under great tension, may escape into the peritoneum through the track of the needle. The skin is incised for three-quarters of an inch at the site of the puncture, and the trocar and cannula, four and a-half inches long and one-third of an inch in diameter, is plunged into the abscess along the track of the exploring needle. As the trocar is withdrawn and pus escapes, the end of the cannula is closed with the thumb until a rubber tube can be introduced. It is better

¹ *Brit. Med. Journ.*, August 24, 1912, p. 405.

² *Lancet*, 1922, i, 463, 569 and 677.

³ *China Med. Journ.*, September, 1924.

⁴ *Lancet*, 1923, ii, 1398.

for the pus not to escape too rapidly, and it is necessary to prevent the entry of the air which interferes with the siphonage. The rubber tube, which is about nine inches long and has been boiled, is somewhat larger than the cannula so that it fits snugly into the puncture in the liver. It is necessary to stretch the tube before it can be introduced. This is done by threading it over a metal rod with a hook at one end. Two side holes are made near the inner end of the tube for better drainage. When the tube has been introduced well into the abscess first the cannula and then the metal rod are withdrawn. About four inches of the tube now project, and the end of it is at once attached to a glass tube connected with another piece of tubing long enough to reach the bottom of a vessel on the floor near the bed. The end of the tube is weighted and kept under the surface of an antiseptic solution otherwise proper siphonage is impossible. The tube is sewn to the skin to prevent it slipping out. Drainage is continued as long as pus escapes.

Incision and Drainage In some cases especially those not due to the *amœba coli* or those of tropical abscess complicated by mixed infection it is to a free incision however that we must look for a permanent cure. This may be employed in three ways.

(1) Direct incision and drainage when tenderness œdema and redness make it probable that adhesions exist. This needs no further comment.
 (2) Incision and drainage by abdominal section.
 (3) Incision and drainage through the chest wall (*vide infra*). When the patient is anaesthetised immediately before the operation, in doubtful cases the liver should be explored with an aspirating needle of medium¹ calibre and four and a half inches long over any suspected area or through the ninth intercostal space in the axillary line, about an inch above the costal margin and therefore below the pleural reflection. The needle is passed upwards and backwards as well as inwards for the abscess is usually in the upper and back part of the right lobe of the liver. If pus be found the operation should be at once proceeded with.

The methods of treating an hepatic abscess by abdominal section, whether in one or two stages have already been spoken of at p. 437 under the heading of Hydatids. They have the following advantages over other modes of treatment: (a) the benefit of a free incision and thorough drainage, (b) the surgeon can see what structures he is dealing with, (c) bleeding from the liver can be seen and arrested, (d) pus can be prevented from escaping into the peritoneal sac by packing etc.

Treatment of Cases of Hydatid or Abscess of the Liver which have opened, or which threaten to open, into the Chest. I refer here to those grave and difficult cases where a hydatid cyst or hepatic abscess, instead of making its way towards the abdominal wall, works upwards, thrusting up the base of the lung. Perhaps the first few tapplings have drawn off fluid from the front, but after this the cyst recedes from the epigastric region. In other and rare cases the cyst or abscess has been opened from the front or the side through the abdomen, but insufficient drainage is thus given. In such cases the fluid must be drained through the chest and below the pleura if possible, in order to avoid the development of

¹ It is essential for the needle to be of good size to allow the rather thick pus to flow. The late Sir Patrick Manson advised that at least six punctures be made before the attempt to find it is abandoned. (*Tropical Diseases* p. 389)

pneumothorax and lessen the risk of infection of the pleural cavity (Figs. 236 and 238).

The pleura may be already adherent in suppurative cases, and this may be indicated by the entire absence of breath and voice sounds and resonance over the lower part of the right lung. Under these circumstances the pleura may be disregarded. It may be remembered that the lower reflection of the pleura forms an oblique line running a little below the sixth rib in the nipple line, the eighth rib in the axillary, the tenth in the parascapular, and the eleventh at the spine. An incision may be so arranged that a portion of one or more ribs or cartilages may be removed and the liver exposed through the diaphragm below the pleural reflection, which may be displaced upwards if necessary. Failing this, the pleura can be obliterated by suture at its lower part before it is incised, so that pneumothorax or pleurisy may be prevented in most cases. The same plan may be adopted also in the treatment of subdiaphragmatic abscess as recommended by Elsberg¹ (see Figs. 237 and 238).

REMOVAL OF PORTIONS OF THE LIVER FOR NEW GROWTHS

Indications. This operation will always remain a rare one from the infrequency of growths which admit of removal. In the majority of cases a definite tumour has been felt in the liver before operation, but in some the tumour is only discovered or proved to be hepatic after the abdomen has been opened. The possibility of syphilis should always be borne in mind and the Wassermann reaction tested before exploration of an hepatic tumour. After the abdomen has been opened it may be difficult to distinguish between innocent and malignant tumours without microscopical examination, and for this purpose a small wedge-shaped portion may be excised and immediately examined and the report obtained within five minutes, so that the exact nature of the operation, if any, may be decided. In the same way inflammatory tumours such as gummata and tuberculous masses may be definitely identified. It may be superfluous to say that gummata do not call for removal but are best treated medically. To be removable a tumour must be primary in the liver, of moderate size and solitary, or confined to a part safe to remove, such as the left lobe. It should have a fairly definite edge and not be infiltrating, so that it can be ascertained beforehand that the whole of the tumour can be removed with a good margin of healthy tissue around it. It is unnecessary to remove simple growths if they are not doing any harm or likely to become harmful. Similarly it is rarely necessary to remove a Reidel's lobe discovered during an exploration. The temperature is often raised by growth of the liver, and this has often led to a diagnosis of hepatic abscess.

Operation. The chief difficulty met with is hæmorrhage; this has, however, been satisfactorily controlled, either by (1) *isolating the tumour by means of an elastic ligature* or (2) *by sutures before removal*, or (3) *dividing the liver-substance with the cautery, and ligating any large vessels met with while this is being done*. The portal vessels should be clamped during

¹ *Ann. of Surg.*, 1901. xxxiv, 729.

the removal but the clamp should not be applied longer than is absolutely necessary¹

(1) *By Elastic Ligature* When the elastic ligature is employed long steel pins are so placed as to prevent the ligature from slipping and the tumour then removed half an inch beyond the ligature. The wound is then closed round the stump which must be carefully kept aseptic. In a case treated successfully in this way by Mayo Robson the pedicle left was as thick as the wrist and after the separation of the slough a granulating surface was left. This gradually contracted and the patient made a good recovery. The inevitable sloughing of the pedicle makes this method

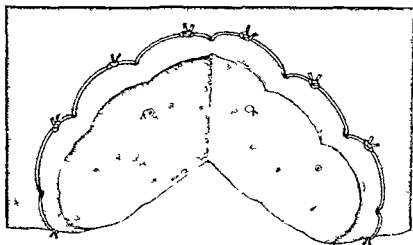


FIG. 240. Excision of part of liver. Bleeding controlled by mattress suture of stout catgut and residual vessels are tied on the cut surface.

unsatisfactory but the elastic ligature is useful as a temporary measure. It is removed after the tumour has been removed and the hepatic wound closed by sutures.

(2) *By Sutures* The best way to prevent hæmorrhage is to isolate the growth by means of stout catgut ligatures passed through and through the liver around the growth before the latter is excised (Inschultz). Any large vessel on the cut surface is tied and the large hepatic wound is closed by sutures passed proximally to the hæmostatic sutures already mentioned (Figs. 240 and 241).

(3) *By Caustery* Keen removed a carcinomatous left lobe weighing one pound and five ounces from a man aged 50 by the latter method which he describes as follows:

The operation was done entirely with the Paquelin cautery. It took from twenty to thirty minutes to sever the left lobe from the remainder of the liver. The hæmorrhage was not very severe, excepting when I burned into some of the larger veins. Each of these when opened I was able instantly to close by my left forefinger. Then temporarily laying aside the cautery I passed a catgut ligature under each by means

¹ Pringle (*Ann of Surg.* October 1908) and McDill (*Journ Amer Med Assoc* 1910 1933).

of a Hagedorn needle, and one of my assistants tied it slowly but firmly. Five ligatures were thus applied. Three of the veins required ligatures of both of the divided ends. The hæmorrhage, except from these large veins, was arrested by the Paquelin cautery, except that occasionally, when I laid aside the cautery to apply a ligature, temporary packing with iodoform gauze was of great service in arresting the parenchymatous hæmorrhage." The cavity left was partially occluded by means of sutures, the remainder being loosely packed with gauze. Complete recovery took place.

In other cases the charred surfaces after suturing have been treated without drainage without any untoward result.

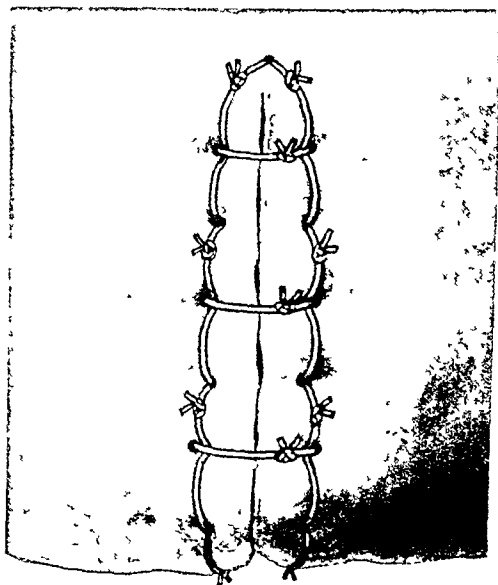


FIG. 241. Control of bleeding and suture of wound of liver with stout catgut sutures

McWilliams¹ reports twenty-five cases of malignant disease of the liver submitted to operation. In eight cases there was fever before the operation, and this led to an erroneous diagnosis of abscess of the liver in three cases. Keen² has collected no less than seventy-four cases in an important paper from which most of what follows has been gathered. The mortality has so far been only 14·9 per cent., so that the risk of the operation is certainly not a very serious one. Some idea of the variety of tumours that have been removed from the liver may be obtained from the following list which Keen gives: Constricted, accessory or herniated left lobe, five cases; syphiloma, twelve cases; carcinoma, seventeen cases; adenoma, seven cases; sarcoma, five cases; angioma, four cases; cavernoma, one case; cystoma, one case; angio-fibroma, one case; small calculi, one case; endothelioma, one case; hydatid cysts, twenty cases.

¹ *New York Med. Journ.*, December 7, 1907.

² *Ann. of Surg.*, 1899, xlx, 267.

Anschultz¹ in 1903 analysed the records of ninety six resections of new growths of the liver. Seventeen died from the operation, ten were treated by excision, tamponade and pressure, with one death, for seven the thermo cautery was used, and all recovered. Of twenty five in which deep ligation and excision were adopted, two died. And out of six in which preliminary clamping was used, two died. Of twenty one done by intrahepatic ligation and excision, six died, and of twenty four in which the elastic ligation was used, six died. In 12½ per cent of the cases the resected mass was gummatous, two of these patients died. The ultimate results of resections for malignant growth have been very poor except in a few cases, only temporary relief having been afforded, and some delay of death in those who have survived the operation. To excise a gumma of the liver is both unnecessary and unjustifiable except perhaps in some cases where preliminary examination of the blood and exploratory operation have failed to indicate the true nature of the tumour. Lockwood has successfully removed a Reidel's lobe for the relief of pain.²

Ransohoff³ excised a mass from the liver, which upon microscopical examination, proved to be tuberculous. The elastic ligation was used, but this cut into the liver and caused profuse hæmorrhage next day. The growth was then removed with the cautery. The patient died a few days later of hæmatemesis of uncertain cause. Mr Grey Turner⁴ successfully removed a tumour, probably an adenoma, weighing two pounds, from the right lobe of the liver of a boy aged thirteen years. The patient was well three years later.

THE SURGICAL TREATMENT OF CIRRHOSIS OF THE LIVER WITH ASCITES—EPILOPEXY

Many years ago Hilton Fagge drew attention to the wonderful dilatation of the venous connections between the systemic and portal circulations which may largely overcome the obstructive results of cirrhosis of the liver.

Professor Talma was the first to suggest in 1889 the operation of epiploexy to increase the collateral circulation "but to Mr Rutherford Morison belongs the credit of having brought the first case to a successful issue."⁵

Mr Morison was quite unaware that any one had previously suggested and already performed the operation when he first tried it and published his paper in the *Lancet* of May 27, 1899.

In a later contribution⁶ he gives the following account of the way in which he was led to operate.

"I can now only claim, for Dr Drummond and myself, that our views and treatment were entirely independent and original. His belief was that, in certain cases of cirrhosis of the liver, ascites might be prevented by an increased circulation through the enlargement of normal channels between the portal and systemic veins. Mine, that if his explanation was correct, it might be possible to cure ascites by

¹ Quoted by H. A. Haubold (*Ann. of Surg.*, 1904, xxxix, 243).

² *Lancet*, July 25, 1903.

³ *Med. News*, April 16, 1904.

⁴ *Proc. Roy. Soc. Med.*, 1922, 23, xvi, Surg. Sec. 43.

⁵ C. H. Frazier, *Amer. Journ. Med. Sci.*, 1900, cxx, 661.

⁶ *Ann. of Surg.*, 1903, xxxviii, 360.

the formation of a new and accessory circulation, for which purpose I devised the operation described."

The normal communications between the portal and systemic veins are not at all free, and are practically limited to two situations: (a) Between the gastric and œsophageal veins at the cardiac end of the stomach, whereby blood may flow from the portal system into the azygos veins and superior vena cava. Sometimes these veins may greatly enlarge in alcoholic cirrhosis, and may rupture into the œsophagus and lead to fatal hæmorrhage.

(b) Between the superior hæmorrhoidal tributaries and those of the middle and inferior hæmorrhoidal, whereby portal blood may reach the iliac and even the axillary and subclavian veins through the superficial and deep epigastric veins.

There is abundant evidence¹ that considerable venous anastomosis takes place through the adhesions formed between the great omentum and the parietes.

Indications. In view of some undoubted recoveries which have followed it, the operation of epiploexy is certainly worthy of consideration, especially when the grave prognosis of alcoholic cirrhosis under medical treatment is remembered. It is a mistake to think, however, that the disease is always fatal even after ascites has developed, and recovery may follow paracentesis in a few cases. Spontaneous recovery is not very uncommon, and complete recovery took place in one of my cases after the implantation of twelve stout silk threads to drain the peritoneal cavity into the subcutaneous tissues of the abdomen.

Epiploexy should certainly be reserved for cases of portal or alcoholic cirrhosis, in which an excess of connective tissue forms around and obstructs the small branches of the portal vein. It is of no value for the relief of biliary cirrhosis in which the fibrosis takes place around the biliary ducts. The operation is not indicated in any late cases, especially when the liver function is below 25 per cent. of the normal or in the presence of cardiac or renal disease. It is most successful in patients who have already stood severalappings. Death may occur from shock, cholæmia, infection or exhaustion.

If the operation is advised, the immediate dangers and the poor prospect of permanent relief should be honestly explained to those who have the ultimate responsibility of deciding for or against it.

Operation. The abdomen is opened under general or local anæsthesia; the latter is not sufficient in some cases, but the former is especially dangerous in these cachectic patients. The incision is made above the umbilicus and near the middle line, the right rectus being drawn outwards. The fluid is drained and mopped away until the peritoneum is quite dry. As far as possible the peritoneal surfaces of the liver, spleen and parietes are roughened by gauze friction, and the great omentum is extensively sutured to the parietal peritoneum which has been rawed by friction. Catgut is the safest suture material to use. Drainage of the peritoneum is not carried out on account of the risk of secondary infection; which used to be a common cause of death; it is better to tap the peritoneum later if necessary.

¹ W. J. Mayo, *Collected Papers of the Mayo Clinics*, 1924, xvi, 220.

W J Mayo recommends two separate right paramedian incisions, the upper one opening the peritoneum the lower one extending as far as the deep layer of the rectus sheath. The great omentum is drawn from the upper wound towards the lower one behind the rectus muscle, and fixed there. Schiassi makes a vertical incision a little below the left costal margin opposite the middle of the clavicle and another one running outwards from the upper end of the first incision. A triangular flap consisting of all the tissues down to the peritoneum is then raised and a vertical incision made in the peritoneum. The spleen and great omentum are withdrawn sufficiently to allow the surgeon to fix them in the wound which is then sutured.

In about one half of the cases of splenic anæmia coming to operation there is secondary cirrhosis of the liver which is checked by splenectomy (see Chapter XIX.)

Results Mr Morison's first case like others before it was unsuccessful but the next a woman was relieved of her ascites and survived for two years when she died from an operation undertaken for ventral hernia the result of the former operation. Another successful case recorded by the same surgeon is quoted in detail below. Sinclair White also records two successful operations both the patients being well a year after the operation¹. On the whole however the operation cannot be said to have been a great success. Out of 105 cases collected by Greenough the mortality was 29.5 and only nine showed improvement after two years.

Monprofit (quoted by Moynihan) collected 224 cases in 213 of which the results were known. About 20 per cent died from the operation and about 20 per cent died subsequently from cachexia or concomitant disease. Recurrence of the effusion took place in about 12 per cent. Improvement occurred in a little over 12 per cent and recovery in about 33 per cent. At the Mayo Clinic² there were seven deaths in 47 cases several patients were well up to nine years after the operation.

It may be concluded that the operation is worth doing in selected cases of portal cirrhosis and is likely to be successful in about a quarter of the cases. Ventral hernia has been a troublesome and dangerous sequel in some instances.

The following is a case of undoubted cirrhosis of the liver in which a brilliant recovery followed an operation by Mr Rutherford Morison.

The patient was an alcoholic man aged 52 who had been tapped 14 times 18 gallons and 2½ pints of fluid having been withdrawn in all but without any permanent relief. Medical treatment and paracentesis having failed the patient was admitted into the surgical wards of the Royal Infirmary Newcastle upon Tyne. The following account is taken from the *Ann of Surg* xxxviii 360. On admission to the surgical ward his condition was described as follows. He was a thin man with sallow complexion sunken cheeks and yellow tinted conjunctiva his tongue was clean and moist appetite fairly good arteries slightly atheromatous pulse ninety two and temperature normal. No jaundice or other disease discovered beyond what follows. His abdomen was much distended and the physical signs were those of a large collection of free fluid the left side of the scrotum was swollen from fluid distending a hernial sac. Dilated subcutaneous veins were visible starting from the neighbourhood of the umbilicus and terminating in one large trunk on either side which

¹ *Brit Med Journ* October 10 1903

² W J Mayo *Collected Papers of the Mayo Clinic* 1924 xvi 231

ran up over the chest into the axilla. The direction of the blood current was ascertained to be from below upward. Percussion showed an increased splenic and diminished liver dulness. There was some œdema of the feet and legs extending as far as the middle of the calf. On August 29, 1899, the patient was operated upon, under chloroform. An incision about four inches long opened the abdomen between the ensiform cartilage and the umbilicus. The subperitoneal fat was vascular, and bled freely. A large amount of clear straw-coloured fluid escaped as soon as the peritoneum was divided. A second opening was next made between the umbilicus and the pubis large enough to admit a half-inch diameter glass drainage-tube, which passed through and into the pelvis. Some adhesion was present between the liver and the omentum, and between the omentum and the abdominal wall. The liver was firm, finely granular on the surface, and of about normal size. The spleen was hard and enlarged to at least double its normal size. The abdominal cavity was dried with sponges. The omentum was fixed across the anterior abdominal wall by catgut sutures. The upper incision was entirely closed by catgut sutures. The lower was kept open for a drainage-tube, through which the fluid was pumped out of the pelvis. Over the dressings, broad long strips of adhesive plaster were applied transversely from the chest above to the drainage-tube opening below. This was for the purpose of keeping the upper part of the abdominal cavity empty of fluid and the parietal closely applied to the visceral peritoneum.

"Two nurses, with a reliable knowledge of antiseptic wound treatment, were told off to look after the tube, and keep any fluid from collecting in the pelvis or from escaping on to the dressings. The operation was well borne, and his recovery straightforward." From ten to twenty ounces of fluid were removed daily for the next fortnight or more, but on October 10 the tube was left out, for there was no fluid coming through it. Three weeks later he was readmitted and 230 ounces of liquid were removed.

"January 3, 1900: Better; signs of very little fluid in belly. From this date there was no further accumulation of fluid, and at the present time (February, 1903) he is very well, never looked better, is fat and strong, and has a good appetite. There are no signs of fluid in the abdomen. The veins in the abdominal wall are very large; he complains of some dragging pain in the abdomen; the liver can be felt adherent to the abdominal wall" (note by Mr. G. Grey Turner, Surgical Registrar). This man was well several years later.

CHAPTER XXI

OPERATIONS ON THE GALL-BLADDER AND BILE-DUCTS

Anatomical Points - An accurate knowledge of the normal and abnormal anatomy of the biliary apparatus is essential to all surgeons who undertake operations on these intricate parts. Flint¹ has drawn attention to abnormalities of the bile ducts and associated blood vessels and has rightly laid stress upon their surgical significance. The arrangement of

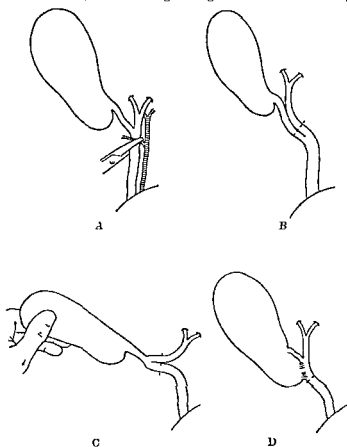


FIG 212

- A Common bile duct clamped with abnormal cystic artery
- B Division of common hepatic duct with parallel adherent cystic duct
- C Traction causing dangerous looping of common bile duct
- D Hartmann's pouch or pelvis of gall bladder adherent to the common duct (after A. J. Walton)

the vessels and ducts given as normal in the text books was found in only 69 out of 200 consecutive dissections. Lack of knowledge of abnormalities and want of care in exposing the ducts may lead to severe hæmorrhage or to grave injuries of the ducts during the operations of

¹ E. R. Flint, *Brit Journ Surg* 1923 x 509

cholecystectomy or choledochotomy. The occasional presence of the right hepatic or cystic artery in front instead of behind or to the left of the common hepatic or common bile-duct may lead to trouble, and so may the presence of the gastro-duodenal or superior pancreatico-duodenal artery in front of the common duct either above the duodenum or just above the ampulla of Vater. An accessory right hepatic duct, which was present in about one-seventh of the cases, is very liable to be divided and, if this accident is not recognised, the escape of bile into the peritoneum may lead to death, especially if the abdomen has been closed without drainage.

Abnormalities of the cystic duct have often led to error. This duct may be absent (Walton), unduly short or abnormally inserted into the common bile-duct, behind or on the left side of the latter; it commonly runs parallel to the common bile-duct and is adherent to it for some distance before actually opening into it. In about one-seventh of Flint's dissections the cystic duct opened into the retro-duodenal part of the bile-duct, so that there was no common bile-duct above the duodenum.

The pelvis of the gall-bladder often enlarges and extends in front or behind the common bile-duct, to which it may be intimately adherent, so that the latter may be mistaken for the cystic duct and divided.

INJURIES OF THE GALL-BLADDER OR BILE-DUCTS

Indications. These are rare accidents and usually they are associated with other abdominal injuries. Subcutaneous rupture may be due to falls or blows upon the abdomen, and they are more likely to happen when the gall-bladder or ducts are distended from obstruction. The immediate results will depend a great deal upon the character of the bile, for if the latter is aseptic there may be no symptoms beyond some initial collapse for some days, whereas an acute spreading peritonitis soon follows extravasation of infective material. Often the abdomen is explored on account of associated injuries such as rupture of the liver, which causes hæmorrhage and collapse. The extravasated bile, if at first aseptic, later becomes infected from the intestine, and a plastic peritonitis ultimately results and generally leads to the death of the patient within two or three weeks. A great deal of lymph is exuded and this often serves to localise the extravasation in the right kidney pouch with the formation of a large cyst containing bile. In many cases there is some jaundice, especially when the main ducts are involved. Sometimes the extravasation and effusion are more general and enormous in quantity, giving all the signs of ascites.

Operation. An operation should be performed as soon as the diagnosis is made, but in many cases it is difficult to make an exact diagnosis, and it is wise to explore as soon as signs of some serious internal injury in this area develop.

When the abdomen is opened the extravasated bile should be mopped up by gauze rolls passed in various directions, while the gall-bladder and its ducts are examined. If there is an opening in the gall-bladder, a tube should be secured in it as in the operation of cholecystostomy. This is generally simpler and safer than suture without drainage. An opening into one of the ducts may be treated in a similar way. Some injuries of the gall-bladder or cystic duct are best treated by cholecystectomy.

If the common bile-duct is completely divided and if the two ends can be found they should be joined together with interrupted sutures of fine catgut and a tube inserted through a separate incision in the proximal part of the duct above the anastomosis. If the lower end of the duct cannot be found or joined to the proximal part the upper end may be anastomosed to the stomach or duodenum or failing this the upper end of the duct may be ligated and cholecystgastrostomy performed.

OPERATIONS FOR GALL-STONES

Cholelithiasis is by far the commonest indication for exploring the gall bladder and bile ducts. Therefore it is necessary to consider briefly the different sites at which calculi are met with the chief evidence of their

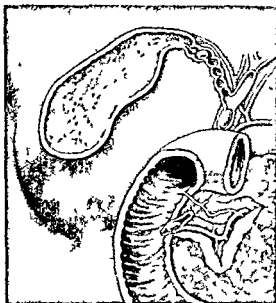


FIG. 243. Anatomy of the biliary apparatus. Stones are shown in the cystic duct, common bile duct and ampulla of Vater. The pancreatic duct of Wirsung and the accessory duct of Santorini are shown; the latter opening separately into the duodenum.

presence and differentiation. It must be understood that several of the following conditions may co-exist causing a confusion of signs and symptoms.

(1) **The Stones are in the Gall bladder.** The symptoms are (a) Recurrent attacks of pain in the right hypochondrium associated with vomiting and local tenderness. These attacks are often mistaken for gastritis. The gall bladder may be feelable during the attack.

(b) A dull aching pain in the right hypochondrium and right shoulder with a distaste for food, chronic indigestion and much flatulence. On deep inspiration there may be a catch or pain in the gall bladder region and local tenderness on palpation. No swelling may be feelable unless the cystic duct is obstructed or cholecystitis with local peritonitis develop. There is no jaundice unless the common duct also is obstructed.

Radiography may show stones in the gall-bladder area or, more commonly, some deformity or defective filling of the pyloric antrum or duodenum either from pressure or adhesions.

(2) **The Stone or Stones are in the Cystic Duct.** There is colic at intervals with a swelling having the characteristics of a distended gall-bladder. Usually this is in the right hypochondrium, but it may reach the right iliac fossa. Jaundice is absent unless the stone is junctional and presses upon or otherwise obstructs the common or hepatic duct. The stone usually falls back and the colic abates after a few hours, but it may remain impacted and cause inflammation with suppuration or even sloughing of the gall-bladder. Grey patches appear at the fundus of the gall-bladder or below the stone in the duct. Perforation may take place with local or general peritonitis, or adhesion to the duodenum, colon or stomach may take place with the formation of a fistula. It is still a common error to believe that gall-stones are unlikely without a history of jaundice, but it should be remembered that, as the cystic duct is narrower than the common duct except at the papilla, more stones get impacted in the cystic duct than anywhere else, and that *jaundice is really an exceptional and late sign of gall-stones*. This error has condemned many patients to years of unnecessary suffering—a diagnosis of gastritis or hysteria being commonly made.

(3) **The Stone or Stones are in the Common Duct.** This according to the duration of the mischief, is more or less dilated. In addition to colic, jaundice usually develops sooner or later, and fever is sometimes present during the attack of jaundice due to an ascending infective cholangitis. Sometimes stones impacted in the common duct do not cause colic, but generally there is nausea instead. There is often tenderness on deep palpation over the common duct. Small stones in a dilated common bile-duct, although they may cause frequent colic, may not obstruct long enough to produce jaundice. Therefore it is imperative to examine the common duct carefully in every case even when there is no history of jaundice. The gall-bladder, as pointed out by Terrier, Mayo Robson and others, is usually contracted, shrunken and matted down by adhesions in these late cases, so that no gall-bladder swelling is evident. In fact, *if the gall-bladder can be felt in a jaundiced patient, the obstruction is probably due to other causes, such as growth of the head of the pancreas or chronic pancreatitis*. In these conditions the pain, although it may be severe, is rarely colicky in nature. Moreover, the jaundice is gradual, progressive and severe, not sudden, remittent or intermittent and moderate as it generally is with gall-stones. Long continued and “black” jaundice is very rarely due to gall-stones. The age, sex and especially the general condition of the patient assist in the diagnosis, for with pancreatitis, and especially with malignant disease, the patient looks more ill and wastes more rapidly than with gall-stones.

Indications for Operation. As a rule radical operations for gall-stones are not urgently required, and are easier and safer when deferred until the acute symptoms have passed; but for obstruction of the cystic duct or neck of the gall-bladder with distension of the gall-bladder which is unrelieved within forty-eight hours, it is often wise to operate in order to avoid suppuration and its complications, such as sloughing of the gall-

bladder and localised or even general peritonitis. In late cases cholecystostomy is often easier and safer than cholecystectomy the latter being deferred.

When gall stones in the gall bladder give rise to symptoms such as repeated attacks of colic or of localised pain and tenderness with flatulent dyspepsia it is wise to advise operation unless there are grave contra indications to the anæsthetic. It is wise to do this in order to avoid the complications already mentioned and also carcinoma of the gall bladder, which is apt to follow the chronic irritation of gall stones and to involve the liver early and become irremovable by the time it is recognised.

Repeated attacks of biliary colic associated with jaundice are almost always due to gall stones in the common bile duct which require removal.

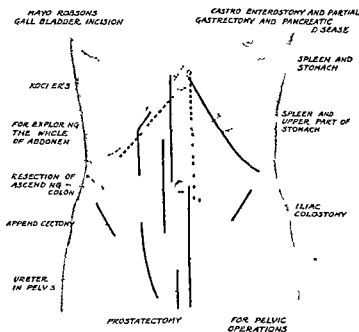


FIG. 244 Abdominal incisions. Kocher's incision all the fibres of the right rectus are divided.

by operation. It is safer to defer this until jaundice has subsided although it may not have cleared up entirely.

It is of the greatest importance to realise that jaundice which is neither slight nor transient and is therefore not catarrhal calls for early exploration and treatment. In this way only can such dangerous complications as infective cholangitis and post operative hæmorrhage be avoided with certainty. Generally it is advisable to wait for a few days when there is fever due to an exacerbation of existing cholangitis for it is safer to operate in a quiet period when the fever has passed.

Preparation of the Patient. It is of the greatest importance to prepare jaundiced patients carefully before operation so as to minimise the risk of hæmorrhage and suppression of the liver functions. Walters¹ injects

¹ *Collected Papers of the Mayo Clinic, 1929* XIV, 164.

intravenously 5 c.c. of a 10 per cent. solution of calcium chloride on three successive days and thus reduces the coagulation time to normal. He also administers carbohydrates and water freely by mouth and glucose and water by the rectum. Calcium chloride gr. i, dissolved in 3i of water and injected intramuscularly once a day for two or three days before the operation, is also valuable. Careful ligation of every bleeding-point and accurate sewing are also very important safeguards against bleeding.

Exploration. An operation for gall-stones is usually, in the first instance, exploratory, the special operation which is called for being then carried out. The steps of the exploration will be described first and the

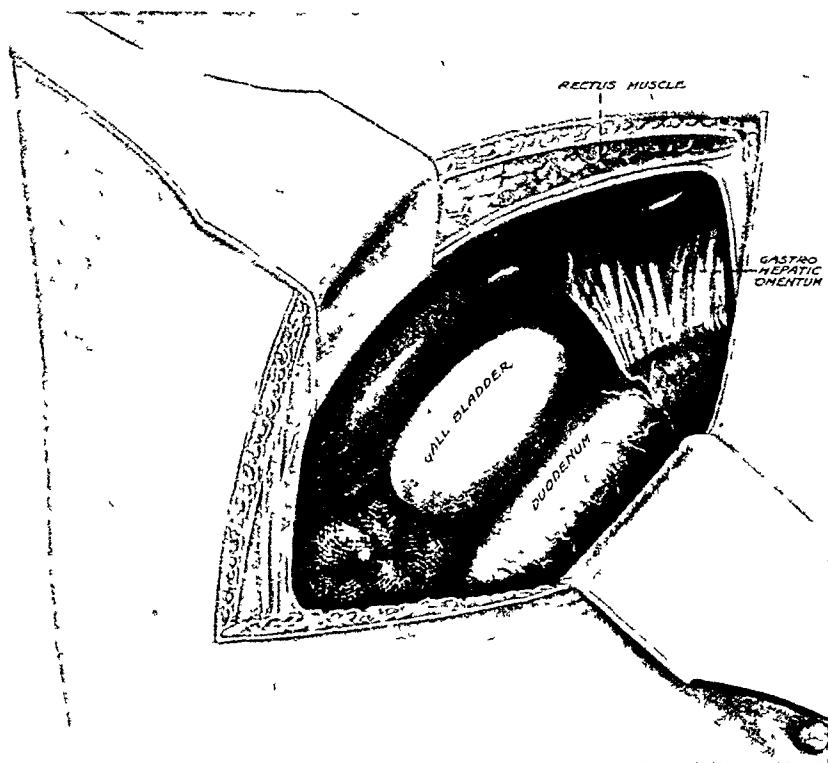


FIG. 245. Kocher's oblique incision across the rectus.

details of the separate operations given subsequently. In order to render the parts more accessible, a rubber pillow is placed or the bridge is raised under the patient's back at the level of the liver. This brings the common duct two or three inches nearer to the surface, and also tends to open out the costal angle and displace the intestines downwards away from the liver. The patient's head is raised and his thighs somewhat flexed to relax the recti. One of the following incisions is made use of :

(1) **Kocher's incision** gives the best access to the gall-bladder and its duct, and makes cholecystectomy much easier than when any other incision is chosen. It runs from just below the lower end of the ensiform cartilage downwards and outwards an inch below the right costal margin, dividing all the fibres of the right rectus muscle and no nerves of any importance. In stout patients the skin and fat are far more extensively

divided and fall out of the way. This incision, from its high position, allows free drainage with little risk of ventral hernia. It is also very much easier to close than is a vertical incision and far less likely to allow protrusion of intestine during the operation.

(2) In some old and feeble patients with distended gall bladder calling for simple cholecystostomy a vertical incision over the gall bladder and generally extending downwards for three or four inches from the prominence of the ninth costal cartilage suffices and causes less bleeding.

(3) A Paramedian incision, half an inch to the right of the middle line, extending from the right epigastric angle to the umbilicus gives excellent access to the common bile duct and is therefore very useful for feeble, jaundiced thin patients suffering from obstruction of this duct. More

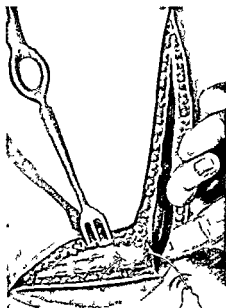


FIG. 246. Perthes incision for operations upon the gall bladder and bile ducts. Preliminary mattress sutures are passed through the rectus and its sheath to prevent retraction of the muscle and hemorrhage.

over, very little bleeding attends this incision an important point when jaundice is present. This incision is especially valuable in recurrent cases when other incisions have been already made further out. In the more usual situations, troublesome adhesions are thus avoided. Perthes divides the rectus at the lower end of this incision in difficult cases.

Whichever incision is chosen every bleeding point is immediately tied with fine catgut before the peritoneum is opened. The abdomen is rapidly explored and the biliary apparatus examined as far as possible. It is of the greatest importance to prevent any infection therefore a dry gauze roll is carefully packed into the right kidney pouch to catch any liquid that may be set free and to protect the stomach and intestines. The edges of the parietal wound are enfolded with large gauze pads.

Omental and other adhesions generally require separating and in doing this great care must be taken to arrest all hemorrhage and to avoid

lacerating any of the adherent viscera. Gauze dissection is usually the safest and easiest method to adopt.

If possible, the liver should be pulled downwards and forwards into the wound, and then tilted so that its lower surface is displayed. The assistant should hold the tilted anterior border of the liver and the gall-bladder,

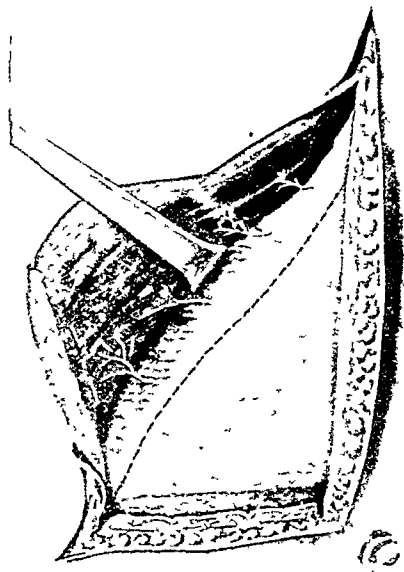


FIG. 247. Perthes' incision for operations upon the gall-bladder and bile ducts. The dotted line marks the site of the incision of the deeper layers.

while the surgeon examines the bile-ducts which are thus brought well forwards into view (see Fig. 248). A gauze pack above and behind the displaced liver sometimes helps.¹ A methodical and careful examination is then made of the gall-bladder and bile-ducts, and the exact nature of the operation to be performed is determined.

CHOICE OF OPERATION

The following remarks are taken from an article by the writer :² The more we study the natural history of the human gall-bladder in health and especially in disease, the more we come to regard it as a useless and troublesome vestigial organ like the appendix vermiformis. Various animals, such as the horse and the rat, get on very well without it, and its removal from the human being is not followed by any serious physiological or pathological changes. It is true that the large bile-ducts dilate to a slight extent after cholecystectomy, but no serious harm results.³ The loss of the gall-bladder as a storehouse for bile and a secretor of mucus is apparently immaterial, for a large number of people have survived cholecystectomy for many years without suffering any inconvenience, provided always that the bile-ducts are patent to allow the bile to flow through without let or hindrance into the duodenum. It is generally

¹ J. G. Masson, *Ann. of Surg.*, 1919, lxix, 422.

² R. P. Rowlands, *Guy's Hosp. Reports*, 1921, lxxi, 454.

³ F. C. Mann, *Collected Papers of the Mayo Clinic*, 1919, xi, 98.

admitted that the gall bladder is the factory of nearly all gall stones which may cause infinite trouble and danger in the gall bladder bile ducts and intestines. The removal therefore of the source of this trouble is very attractive to the surgeon and advantageous to the patient provided that it can be done without undue risk. But if an irremovable obstruction of the common bile duct develops later the loss of the gall bladder is certainly a disadvantage for cholecystenterostomy cannot be performed to relieve jaundice and choledochenterostomy is a much more difficult operation. Carcinoma of the head of the pancreas common bile duct or duodenal papilla may land the patient and surgeon in this dilemma but these generally run a rapid course and end fatally in a few months even when the jaundice is relieved by short circuiting the bile into the intestine or by draining it away on to the surface of the body. It is commonly said that the removal of a stone left behind or subsequently forming in the common bile duct is very difficult after the gall bladder has been excised but this is a fallacy because the stone itself is an excellent guide to the common duct.

We need not therefore hesitate to remove the gall bladder for any just cause such as disease limited to the gall bladder and the cystic duct provided that the operation can be done without undue risk. Its chief rival is cholecystostomy cholecystostomy being hardly worth considering. The question is more conveniently discussed under two headings according whether the disease is limited to the gall bladder or not.

(1) **When the Disease is limited to the Gall bladder** Increasing knowledge and experience of the surgery of the gall bladder and especially of the ultimate results of a very large number of these operations compel us to change our estimates of the relative merits of cholecystectomy and cholecystostomy. It has been a common belief that draining is always much safer than excising a diseased gall bladder but experience proves that—with a proper selection of cases the reverse is often true. Thus the mortality of 2 493 cholecystectomies performed at the Mayo Clinic¹ between 1907 and 1916 was 1.3 per cent and that of 2 851 cholecystostomies was 1.5 per cent. It is often much easier cleaner and safer to remove a diseased gall bladder and its duct than to remove all the stones from the gall bladder and especially from a tortuous and indurated cystic duct. Stricture may follow incision of such a duct. Moreover the convalescence and ultimate results of cholecystectomy are very much more rapid and satisfactory in every way. After cholecystostomy recurrence of symptoms and secondary operation are infinitely more common. This is what we should expect for nearly all gall stones are formed within the gall bladder and are secondary to pathological conditions affecting it which although ameliorated are not often cured by drainage. The primary disease generally infective in nature is in the walls of the gall bladder in which micro organisms have been shown by Rosenow² to persist indefinitely after drainage. This chronic cholecystitis may cause recurrence of cholelithiasis recurrent acute attacks of inflammation secondary reflex and infective changes especially in the stomach duodenum and pancreas thus setting up chronic dyspepsia and even ulceration of the stomach and duodenum and also chronic or acute

¹ C. H. Mayo *Collected Papers of the Mayo Clinic* 1916 viii 274

² *Collected Papers of the Mayo Clinic* 1916 viii 22²

pancreatitis. Chronic septic absorption from the gall-bladder is a potent source of infective arthritis or "rheumatism," often leading to serious disablement and deformity.

Patients are frequently very dissatisfied after cholecystostomy on account of recurrence of symptoms, biliary or mucous fistula, mucocele or empyema of the gall-bladder. Jaundice, either intermittent or chronic, may develop, due to stones overlooked or reforming in the gall-bladder and travelling into the common bile-duct, or due to stricture or

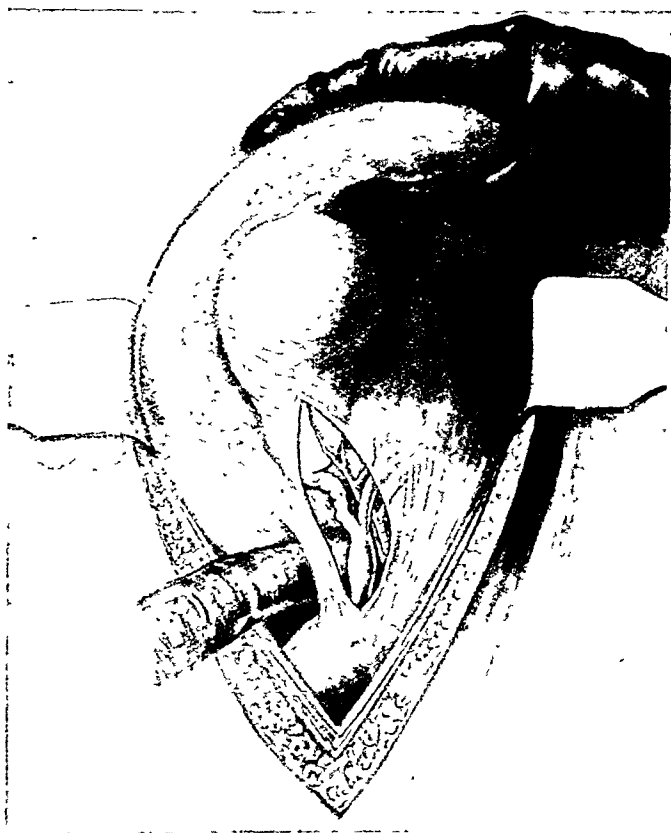


FIG. 248. Choledochotomy. Exploration of the bile-ducts. All the ducts and the hepatic artery are seen, and a finger in the foramen of Winslow holds up a stone in the common bile-duct.

kinking of the common bile-duct owing to the fibrosis and contraction of the gall-bladder adherent to the anterior abdominal wall. In some cases the infective condition of the gall-bladder spreads into the bile-ducts and sets up infective cholangitis or, in suppurative cases, it may spread into the portal veins causing pylephlebitis. Adhesions forming between the gall-bladder and the pylorus and duodenum not uncommonly cause stenosis and delay in emptying the stomach.

Another reason for removing a diseased gall-bladder is that it may be the seat of early malignant disease, which can sometimes be discovered only by microscopical examination after it has been removed.

Dr J G Sherrill¹ draws attention to the frequency of this complication in late cases and the present writer has been surprised to find unsuspected early carcinoma in many gall bladders which he had removed for cholecystitis with or without cholelithiasis. The hope of cure in these early stages of cancer is very good. One of my patients operated on fifteen years ago is still in good health. Moreover our experience of the evil influence of chronic inflammation on the incidence of malignant disease here and elsewhere teaches us that the risk of the subsequent development of carcinoma in a chronically inflamed gall bladder is worth serious consideration and should influence us to remove the diseased gall bladder whenever possible without undue risk.

It is clear that cholecystectomy is more radical and generally satisfactory than cholecystostomy but it is not always the easiest and safest operation. In cases when the patient is very ill, old or feeble when the gall bladder is very inflamed, distended and adherent the surgeon, especially if he is not very experienced in this branch of surgery, will be wise to choose cholecystostomy. The gall bladder can be removed later if necessary.

Incidentally it is right to say that the surgery of the bile apparatus like that of the stomach and duodenum is not to be lightly undertaken by the amateur or the novice. The interests of the patient as well as the good name and honour of surgery demand special skill and experience from the surgeon who undertakes this work for it is impossible to tell what difficult and unexpected problems may present themselves and have to be promptly solved when the abdomen is opened. These operations sometimes so easy and safe on the other hand frequently prove some of the most difficult and hazardous in surgery. When medical men realise these facts we may hope to see fewer bad results and secondary clearing up operations such as cholecystectomy and choledochotomy for the removal of stones left in the common bile duct and the repair of fistulae and strictures following injuries of the bile ducts.

(2) **When the Disease is not limited to the Gall bladder.** There is more room for doubt about the indications for cholecystectomy when the disease, especially cholelithiasis, has extended into the main bile-ducts. It is evident that the gall bladder should not be removed unless it is certain that the common bile-duct is patent and likely to remain so. It is also clear that it is too risky to be undertaken when the patient is very ill, old or feeble and especially in the presence of jaundice which has lasted long enough to diminish the coagulability of the blood—as shown by a previous estimation of the clotting period—thus adding to the danger of uncontrollable bleeding after the operation. No one again would suggest the removal of the gall bladder when infective cholangitis exists for in this grave condition the only justifiable operation is the removal of stones and the drainage of the common bile duct and this should if possible be deferred to a quiescent period.

Under favourable conditions when the bile ducts are patent and free of stones it is however very advantageous to the patient to have the diseased gall bladder removed and thus to be saved from recurrence of symptoms with or without a subsequent radical operation.

¹ *Ann of Surg* 1906 xliv 860

The following cases¹ illustrate some of these points :

CASE 1. Mr. A. C., aged 53, a powerful, stout man, had had cholecystostomy performed for acute cholecystitis in August, 1921, through a long vertical incision made below the ninth right rib cartilage. The operation was said to have been a difficult one, but it was thought that all the stones had been removed. Recovery was slow, but ultimately the man returned to work. He was re-admitted into hospital before Christmas for return of symptoms, but these abated, and he was sent out without further operation. A few days later he was laid up with fever, ? influenza, probably cholecystitis. Another attack came on soon after, with violent pain in the right hypochondrium and slight jaundice. The gall-bladder could not be felt, but there was general rigidity and dulness in the right hypochondrium. An immediate operation was advised, but the patient would not undergo it until he was promised that every endeavour would be made to make it final and radical.

Operation (January 16, 1922). Kocher incision. Very dense adhesions were found between the liver (lower edge) and the parietes, and much blood-stained bile below and above the right lobe of the liver. The adhesions were separated with great difficulty. The gall-bladder was empty and had perforated on its lower surface. Although the foramen of Winslow was defined it was impossible to palpate the common bile-duct to decide if there were any stones in it, owing to the great inflammatory oedema of the sub-peritoneal tissues and of the head of the pancreas. A small stone was felt in the cystic duct and this was extracted with difficulty after opening the duct. No more could be felt. The common bile-duct was opened and a large olive-headed probe was passed into the duodenum and up into both right and left bile-ducts without difficulty and without encountering any stone.

Although the patient was very ill, it was felt that he would not remain well unless the gall-bladder was removed. This was done with difficulty, owing to adhesions and inflammatory changes about the ducts, which made it difficult to define them. When the gall-bladder had been removed another small stone was found in the cystic duct. This was a great surprise. The common bile-duct was drained and the patient made a good and rapid recovery. He has remained quite well for four and a half years.

CASE 2. Mrs. H., aged 49. There was a history of repeated attacks of hepatic colic, without jaundice, since 1917. Cholecystostomy was performed elsewhere in November, 1919, and seventy-two stones removed. Patient remained well until February, 1922, when attacks of very severe pain recurred at frequent intervals, each attack lasting from half an hour to three hours. There was no jaundice.

Operation (March 15, 1922). Cholecystectomy performed. There were no gall-stones, but a greatly enlarged, folded,² inflamed and adherent gall-bladder, containing mucus and bile. A chronically inflamed appendix was also removed. The patient made a good recovery.

CASE 3. Mrs. K., aged 64, had had cholecystostomy performed elsewhere in 1914. In 1916 the attacks of biliary colic recurred, and during the next six years she had six severe, and many minor, attacks. They were attended by nausea, vomiting and flatulent distension.

Operation (May 25, 1922). Cholecystectomy performed. The gall-bladder was found to be full of stones, and several were also removed from the common bile-duct. The patient did very well.

CHOLECYSTOSTOMY

If the gall-bladder is distended and free from adhesions, it is isolated by means of sterile gauze, then aspirated. But before it is empty any stone impacted in the cystic duct is gently squeezed back into the gall-bladder ; for it is far easier to do this now than when the gall-bladder is empty. If, on the other hand, the gall-bladder is small and shrunken and embedded in adhesions, these must be very carefully separated. In some cases the gall-bladder may be actually buried in adhesions, involving such structures as the abdominal wall, omentum, duodenum and pylorus.

¹ Published in the *Brit. Med. Journ.*, 1922, ii, 541.

² The gall-bladder was flexed and kinked because it had been drained backward through the loin.

A gauze pack must always be placed in the right kidney pouch where any escaping liquid and blood will gravitate. While the adhesions are being separated the operator must be prepared in some cases for an escape of pus which has been shut in by these adhesions outside the gall bladder.

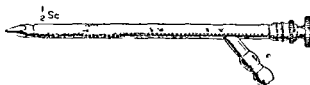


FIG 249

The gall bladder is brought into the wound if possible and having been isolated by means of gauze pads it is first emptied by aspiration (see Fig 249). The puncture is then enlarged and the gall bladder held and steadied with forceps while a forefinger is inserted to feel for calculi.

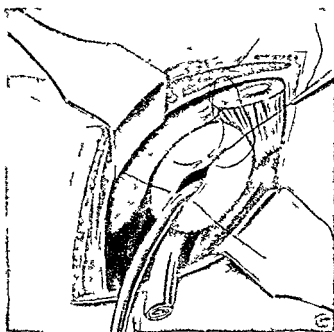


FIG 250 Cholecystostomy. A rubber tube is fixed in the gall bladder with a catgut suture. The incision in the gall bladder is closed with inverting sutures of catgut. A soft folded piece of rubber sheet or drainage tubing is used to drain Morrison's pouch. Both the drains are brought out at the outer angle of the wound which is closed in layers.

Any calculi which lie near the surface are removed with scoops or forceps. Where a stone impacted in the cystic duct resists all efforts at extraction from the gall bladder by scoops or forceps, attempts must be made to push it up into the gall bladder with two fingers of the left hand introduced into the abdomen below the duct. At the same time the scoop or forceps may be used with the right hand. If all attempts at removal or dislodgment fail either the duct must be incised over the calculus or cholecystectomy performed according to the comparative ease and safety of these measures in the particular case.

Very rarely in grave cases, especially with suppuration, the surgeon will have to be content with drainage of the gall-bladder; later the calculus may become dislodged spontaneously and be discharged externally. Injections have occasionally been successful in removing the stone. If the mucous fistula persist and cause serious inconvenience, a secondary operation, generally cholecystectomy, may have to be undertaken for its treatment, under more favourable circumstances.

To drain the gall-bladder a rubber tube of a quarter of an inch diameter should be passed into it for about an inch and fixed in position by means of a single catgut suture piercing the sero-muscular coats of the gall-bladder and the side of the tube. A purse-string or a continuous sei-

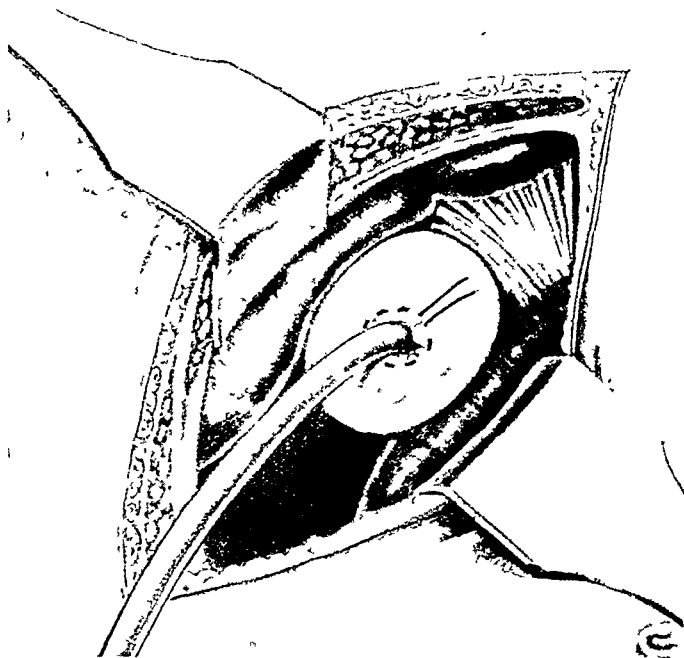


FIG. 251. Cholecystostomy. A purse-string suture closes the opening in the gall-bladder in a watertight manner.

muscular suture is then inserted and tied as the tube is pushed inwards. This procures inversion of the edges of the incision, the serous surfaces become approximated and the tube is held firmly so that no leakage can occur. There is no need to sew the gall-bladder to the parietal peritoneum, a step which is not always easy or safe when the gall-bladder is small and inelastic; the traction exerted upon the cystic duct may cause kinking of the common bile-duct, with persistent biliary fistula. The rubber tube is fixed to the cutaneous edge of the wound, in order to prevent its premature removal by any accidental traction upon it. The outer end of the tube is fixed in a bottle secured at the side of the patient. The tube loosens and comes away after about a week, and the fistula rapidly closes if there is no obstruction in the biliary passages.

There is no danger in letting the gall-bladder fall back if the draining-tube has been properly fixed in a watertight manner. In doubtful cases a

slit tube is placed just below the gall bladder to guard against all risk of leakage (*see* Fig 250)

Often it is better to excise the useless and contracted gall bladder and this is all the more justifiable because the thickened wall may be already in an early stage of carcinomatous disease. Many cases have been

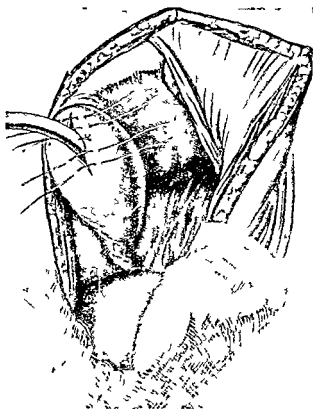


FIG 252 Cholecystostomy. A tube has been stitched to the edge of the incision and the latter is closed with interrupted Lembert sutures

recorded in which the gall bladder has been discovered after its removal to be affected with malignant disease although this was not even suspected at the operation. The packs are removed and the back is allowed to drop to make the sewing easier. The parietal wound above the tube is closed in layers in the usual way.

CHOLECYSTOTOMY

Here the gall bladder is completely closed after the extraction of the stones. This step has grave objections. (1) It is not so safe as cholecystostomy, owing to the risk of leakage if the walls of the gall bladder are at all inflamed and softened. This is just an instance of an operation where we hear of the successful but never of the unsuccessful, cases. (2) It is not always easy to be certain that all the ducts are patent. If a stone be left behind, suturing and returning the gall bladder will give rise, in the immediate future, to dangerous tension on the sutures by the

back flow of the bile, while it prevents the escape of the stone, blood-clot or infective material through the open gall-bladder. (3) When the gall-bladder is left after the removal of gall-stones, drainage is essential for the successful treatment of the chronic or acute inflammatory conditions, which partly cause and partly result from the lithiasis. For these reasons the operation has been abandoned by most surgeons and replaced by either cholecystectomy or cholecystostomy.

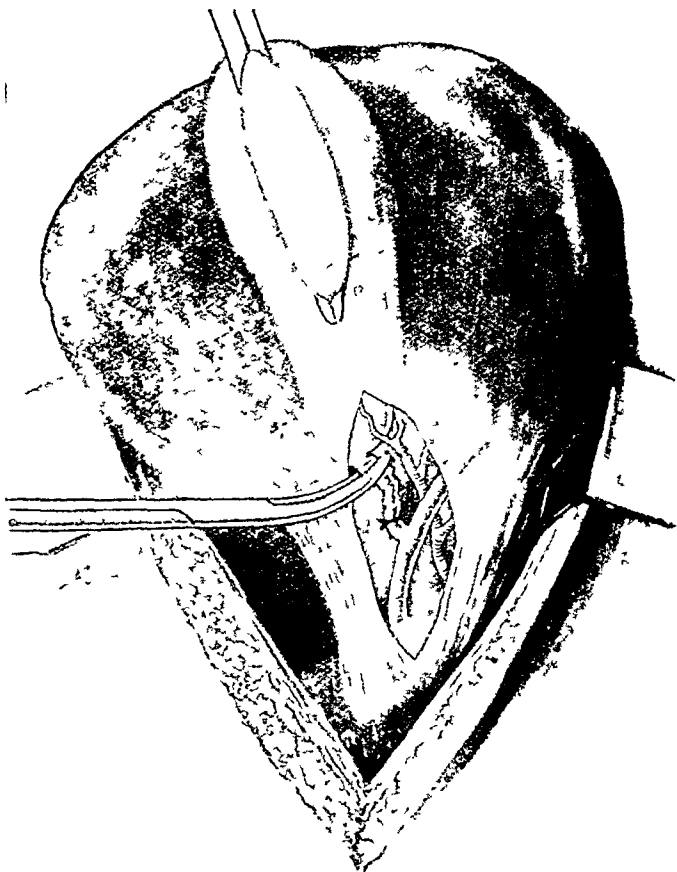


FIG 253. Cholecystectomy. The cystic duct has been tied and clamped after the ducts have been well displayed. The gall bladder is held up with forceps.

CHOLECYSTECTOMY

The chief indications for cholecystectomy are irreparable wounds injuries or diseases of the gall-bladder and its duct, in cases where the common bile-duct is healthy and patent. The following are the most important of these diseases :

Acute, chronic and recurrent cholecystitis, especially when associated with gall-stones.

Gangrene.

Perforation, with or without cholelithiasis.

Operation. The exploratory part of the operation has been already described at p. 456. As already stated, Kocher's incision is much the best for this operation (Fig. 244). This starts just below the tip of the ensiform cartilage, and runs obliquely downwards and to the right, one and a half inches below the costal margin. It descends a little towards its outer end and completely divides both the muscular fibres and the fibrous sheath of the right rectus muscle. Cutting across the rectus sheath gives far better access than vertical slitting. If necessary the incision may be prolonged slightly into the muscular fibres of the external oblique without dividing any of the intercostal nerves. This gives a direct and wonderful view, almost abolishes the need of retractors, and its lower edge keeps the intestines from prolapsing. Hernia is very rare after this incision, even when drainage has to be adopted (Fig. 245).

Every bleeding vessel is immediately tied with fine catgut and the transversalis and peritoneum are incised freely. The falciform ligament is also clamped and divided if necessary. The abdomen is rapidly explored unless there is some contra-indication, and the whole biliary apparatus is always carefully examined, for it is vital to determine if the common bile-duct is normal, to see if its first part, above the duodenum, is dilated or not, and to palpate its second and third parts, the head of the pancreas and the duodenal papilla for stone, induration or growth.

If the disease is limited to the gall-bladder and its removal is considered, after due deliberation, to be both necessary and wise, the liver is displaced downwards and rotated, if possible, a gauze pack being placed above and behind it, if necessary, to retain it in this advantageous position. A dry gauze roll is carefully packed into the right kidney-pouch and a large aseptic pad, with tape attached, is fixed at the inner part of the wound to protect the stomach and duodenum. When the gall-bladder has been carefully freed from adhesions to the omentum, colon or duodenum its fundus (and often its dilated, prolapsed pelvis also) is seized with forceps and drawn forwards by an assistant while the surgeon exposes the cystic duct by incising the peritoneal fold extending from the gall-bladder to the front margin of the foramen of Winslow. When the gall-bladder is large, distended and folded downwards awkwardly at the neck it is first emptied with a trocar and cannula.

Careful blunt dissection soon displays the duct and, to avoid any chance of error, this must be followed from the gall-bladder to its junction with the common bile and common hepatic ducts, which must be clearly displayed. For this, patience and a good light are essential. When the cystic duct has been carefully dissected out of its bed, it is tied with catgut, about a quarter of an inch from its termination, and divided between the ligature and a firm long-handled, curved clamp which prevents leaking from the gall-bladder and is useful for gentle traction. The cystic artery and vein are similarly isolated, tied and divided as they pass forwards usually between the cystic duct and the liver. The greatest care is necessary to avoid clamping or wounding the common hepatic duct, its right tributary or an accessory right hepatic duct. It is all too easy to injure these, particularly if the gall-bladder is distended or folded at its neck and the connective tissues in the fissure inflamed, œdematous or indurated. This danger is increased if the cystic artery is not well secured

but is carelessly divided and allowed to retract and bleed in the depth of the wound

The gall bladder is now separated from the liver from behind forwards by blunt dissection with the finger. The peritoneal covering is saved as far as possible until the separation is nearly completed. It is then so divided with scissors that the edges can be sewn together to cover the raw surface of the liver. This arrests hæmorrhage from the liver and minimises a lésion. Occasionally when there are very dense adhesions about

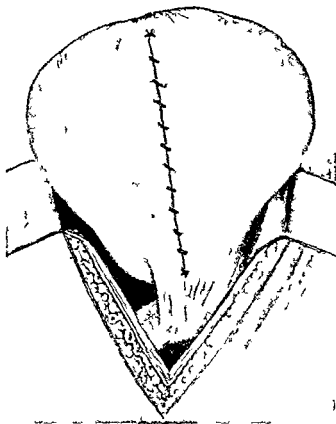


FIG. 50. Cholecystectomy. The operation completed by suture of the peritoneum over the raw surface of the liver.

the neck of the gall bladder it may be safer to separate it from before backwards but as a rule this is more tedious and causes more bleeding. Rarely it is safer to open the bladder along its inferior surface and to trace its mucous membrane back to the cystic duct.

The stump of the cystic duct is buried and the raw surface of the liver covered by sewing the flaps of the peritoneum over them. Unless all oozing has been stopped it is wise to drain the wound at its outer angle with a small short soft rubber tube for thirty-six hours.

The air is released from the rubber cushion or the bridge is let down and the parietal wound is accurately closed in layers.

OPERATIONS ON THE COMMON BILE-DUCT

CHOLEDOCHOTOMY

The common bile-duct is frequently opened to remove stones obstructing it. Often the patient is jaundiced, but sometimes the obstructive attacks are so transient that jaundice is entirely absent. I removed three stones from the common bile-duct of such a patient, who for seven years had been seized with colic about once a week without jaundice at any time. She had had her gall-bladder removed seven years before I saw her, but the colic had continued. The colic ceased at once when the stones were removed. It seems clear that the stones in the common duct had been overlooked at the first operation.

The common bile-duct becomes smaller towards its termination, its diameter being about 8 mm. in the first part, 5 mm. in the second part and $3\frac{1}{2}$ mm. in the intramural or third part, where it may be narrower than the cystic duct,¹ which is about 3 mm. or one-twelfth of an inch in diameter.

In its first part the duct is fortunately near the free edge of the lesser omentum in front of the portal vein and to the right of the hepatic artery.

While the important relations of these ducts—especially the common—must always be remembered, the presence of the stone itself forms a reliable guide, as long as the incision is made directly over it. An inflamed or calcified lymphatic gland or a fibroid lobule of the pancreas may be mistaken for a stone.

Operation. The preliminary exploration is described at p. 145, Figs. 244, 245 and 248.

(1) **Stone impacted in the First Part of the Common Bile-duct**, above the duodenum. The incision in the abdominal wall being lengthened if necessary so as to give satisfactory exposure of the parts concerned, the liver is tilted and held up, the edges of the wound are held widely open and the position of the stone accurately defined. The area of the operation is then carefully shut off by sterile gauze packing, and any adhesions carefully separated by gauze dissection. All bleeding-points are ligatured at once. The left index finger is passed into the foramen of Winslow behind the first part of the duct, and the whole of the duct is carefully palpated as the thumb is moved down along the front of the duct as far as the duodenal papilla. A stone felt in the second or third part is pushed back into the first part if possible, because this makes its removal much easier and safer. It is much easier to displace the stone before incising the duct and letting out the bile. The stone is firmly held and raised by the finger behind it. The incision in the peritoneal covering of the duct is not to be made until the surgeon feels certain that he is directly over the stone and well above the duodenum, where there are very rarely any vessels in front of the duct. Lower down vessels may be encountered; if any are divided they should be tied at once. Occasionally the cystic artery passes up in front of the duct. The duct with the prominent stone within it projects forwards from its sheath; its consistence and greenish colour also serve to distinguish it, but the portal vein (which usually lies behind it) has been mistaken for it and opened. If there is any doubt it

¹ Padula, *Ann. de Med. Navale*, November, 1903.

is wise to aspirate with a glass syringe and a long fine needle. If the vein be accidentally opened, bleeding can be instantly checked by seizing it with the finger and thumb or artery forceps, and the opening closed with a lateral ligature or suture of fine linen thread which is more secure than catgut. An ample longitudinal incision is made in the duct so that the stone can be easily removed without crumbling. The stone often shoots out or is pressed out by the finger behind the duct. Two mattress sutures may be introduced into the wall of the duct before incising it. These serve to close the incision afterwards and also act as guides. The escape of bile, which may be profuse and often infective if it has been long pent up or if the blocked duct is dilated, must be met by assiduous sponging and previous packing of the kidney pouch of peritoneum.

After removal of the main stone the ducts must be thoroughly and systematically explored, for, as has already been pointed out, there are often several stones present, and the failure to remove them all will render the operation useless. In late cases of obstruction of the common duct, stones may have formed in or backed into the hepatic ducts and may be overlooked and give rise to recurrence of symptoms. This exploration should be carried out with the finger if the ducts are sufficiently dilated or, failing this, by a large bent probe or small scoop. The finger however, should be employed wherever possible, because it is the most certain. It is passed both up and down. By conjoint work from within and without the duct a stone impacted low down may be dislodged and removed. The large olive headed probe should be passed into the duodenum to make certain that the papilla is patent and to enlarge the opening if necessary so that any stone or debris left behind may easily escape into the bowel. It is often wise to clear out debris by means of a gauze strip passed into the duct. W J Mayo¹ states that "in nearly one third of the deaths which followed operation on the common duct for stone in one series autopsy revealed that all stones had not been removed."

Drainage. The ducts having been cleared it remains to consider the different means of treating the opening in the duct. When the gall bladder has been opened and the cystic duct is patent a tube inserted in the gall bladder and a large tube in the kidney pouch may provide enough drainage, and the opening in the common duct can be closed with fine catgut sutures. With a free incision, arching of the back and tilting of the liver, the sewing is usually easy, but in very stout women it may be difficult, and time should not be wasted upon vain attempts to do what is not at all essential provided the kidney pouch and the duct are drained.

In most cases, it is not advisable to close the incision in the common bile duct, especially if there is septic cholangitis and if the gall bladder is not available for drainage. A tube may be passed through and tied in the root of the cystic duct when the gall bladder has been removed. Many surgeons prefer not to close the duct completely, as a rule, because of the safety and the beneficial effects of drainage, and the risk of narrowing of the passage by suturing. Moreover, blood clot may occasionally obstruct a sutured duct.²

It will be safer always to drain in some form or other whenever the

¹ *Lancet* 1923, i, 1299

² R P Rowlands, *Guy's Hosp Reports*, 1912, lxxi, 219

ducts have been incised. A long rubber tube $\frac{1}{6}$ inch in diameter is passed into the common duct and upwards towards the hepatic duct and secured in position by means of a catgut suture, which pierces the side of the tube and the edges of the wound in the peritoneal sheath of the duct (see Fig. 256). The part of the tube within the duct has one or more side openings in it. One or more catgut sutures may be inserted if necessary to close the opening in the duct snugly round the tube. To prevent contamination of the peritoneum, a rubber tube $\frac{1}{2}$ inch in diameter

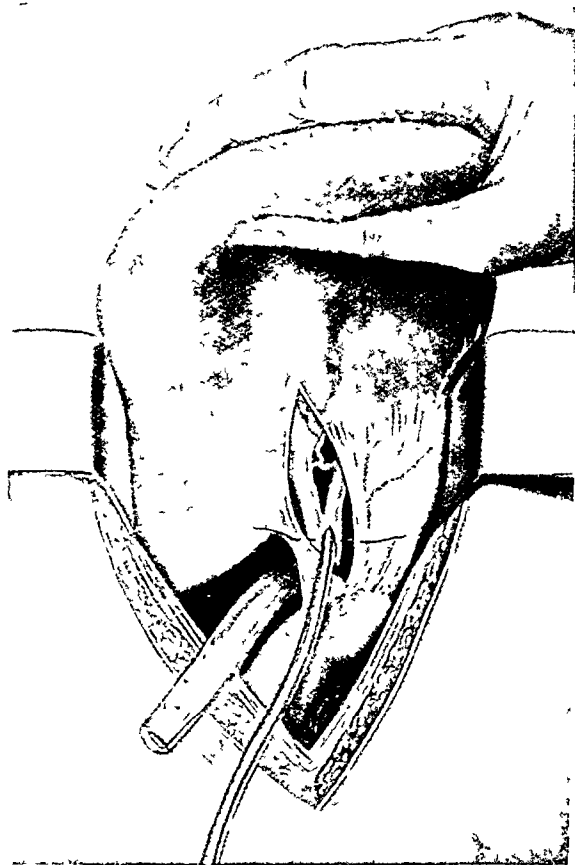


FIG. 256. Choledochotomy. A small rubber tube sewn into the common duct with a catgut suture. This drains into a bottle by the patient's side. A folded piece of soft sheeting is placed in Morison's pouch.

is passed into the kidney pouch below and outside the wound in the common bile-duct. In some cases, especially when a vertical parietal incision has been used, drainage may be established through a stab wound in the right flank. Mr. Rutherford Morison, of Newcastle, has drawn attention to the importance of draining the kidney pouch.¹ He shows that in the right hypochondrium, between the liver and the colon, is a natural space with barriers which separate it, more or less completely, from the general sac. Bile may be allowed to escape into this space as long as it is efficiently drained by an incision made through the posterior

¹ *Brit. Med. Journ.*, 1894, ii, 968.

parietes immediately below the lower end of the right kidney. If the Kocher incision be made use of, the drainage tube will be in the lower and outer angle of the wound.

W J Mayo¹ does not drain the common bile duct after removing quiescent or latent stones from it, but closes the opening with interrupted catgut sutures and drains Morrison's pouch with a soft rubber tube.

The bile is conducted into a bottle by the side of the patient and secured in proper position by tapes. In all cases it is wise to sew the tubes separately to the skin, so that they may not be accidentally withdrawn.

The fine tube will become detached in about a week, and may be removed. The larger tube draining the kidney pouch may be safely and

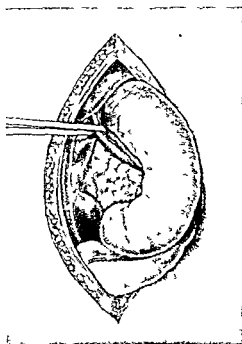


FIG. 257. Cholecystectomy. The stone is firmly impacted in the second part of the common bile duct, behind the duodenum, which has been mobilised and turned over to the left. The duct was embedded in the head of the pancreas.

easily withdrawn after two or three days. Gauze wicks, plugs or packs are unnecessary and harmful, their removal causes needless pain, delay in healing and sometimes hæmorrhage.

Where the duct has been closed with sutures it will still be wise to use a drainage tube for three days, the indication for this being clearer in cases where the suturing has been attended with difficulty, where the edges of the duct are much bruised and where any contraction may exist in the biliary passage below.

Rotation of the Duct. I have often used this method of Moynihan with great advantage. When the gall bladder is shrivelled, empty and embedded in adhesions, and the patient too ill for a prolonged operation, the adhesions need not be separated but, with the left hand passed to the

¹ *Loc. supra cit.*

left in front of the lesser omentum and flexed, the common duct with the stone within it as a guide is pushed forwards and to the right into view below the adhesions. A suture is passed into the duct wall, and an incision is made over the stone in the usual way. Much time and trouble may be saved by this manœuvre.

(2) **Stones impacted in the Second Part of the Common Bile-duct** behind the duodenum and the head of the pancreas¹ or within the latter.

If possible the stone should be pushed upwards into the first part of the duct, whence it can be more safely and more easily removed. Failing this, the duodenum may be mobilised by incising the parietal peritoneum about an inch to the right of the descending part and turning the latter forwards and inwards. Then the calculus is sought, and if found it serves as the best guide to the duct, which may be embedded in the head of the pancreas. When the stone has been found it may now be possible to push it back into and remove it from the supra-duodenal part of the duct. If this is not possible the duct must be incised over the calculus, which is removed and drainage always established. Berg² recommends this method in preference to duodeno-choledochotomy.

The objections to this route are that it is difficult and may be accompanied by troublesome hæmorrhage from the pancreas, but usually the pancreatic tissue around the duct is fibrous from chronic inflammation, and does not bleed much. Bleeding is best controlled by suture.

In such cases it is easier and safer to adopt the trans-duodenal route, as Kocher did in one case, on account of severe hæmorrhage from the pancreas which made him give up the retro-duodenal route.

(3) **Stones impacted in the Ampulla of Vater. Duodeno-choledochotomy** (see Fig. 258). Dr. McBurney was the first to perform this operation in 1891. He lays stress upon the following procedure :

"In all cases which are not complicated by very deep adhesions, involving the common duct and descending portion of the duodenum, it is easy and very desirable after determining the presence of a calculus in the lower part of the duct to pass the left forefinger through the foramen of Winslow to a point behind the calculus. With the finger, the lower end of the common duct, the calculus and the descending portion of the duodenum can be lifted forward so as to bring these parts nearly or quite to the level of the abdominal incision.³ The duodenum is then incised in its anterior wall for from an inch to an inch and a half, the orifice of the duct (which is usually markedly altered as to the colour, etc.) is easily found and enlarged with knife or scissors or forceps and the stone removed. All of this, and even suture of the intestinal wound, should be completed without removing for a moment the left forefinger from its supporting position."⁴

When an incision is made through the posterior wall of the duodenum into the common bile-duct before it becomes intramural, as in Kocher's case, extravasation of bile may occur into the retro-peritoneal tissues,

¹ A stone impacted in the duct, low down, may give a hard or nodular feel which may suggest malignant disease of the head of the pancreas; an exploring needle will clear up the case.

² *Zent. f. Chir.*, 1903, No. 27.

³ If the duodenum is not mobile enough, the peritoneum to the right of it may be incised to the required degree.

⁴ Dr. Hancock, *Ann. of Surg.*, xl, 72.

unless the incision in the duct is accurately sewn, as advised by Kocher when the papilla is patent if any obstruction exist at the orifice the edges of the incision into the bile-duct should be sutured to those of the wound in the posterior wall of the duodenum thus establishing a fistula between the gall duct and the duodenum.

If an incision has been already made into the common bile duct in its first part a piece of gauze may be drawn downwards from it to the

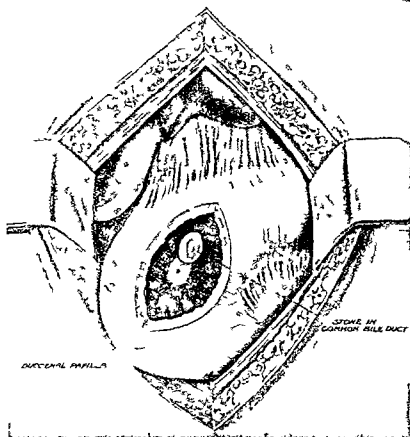


FIG. 258. Duodenocholedochotomy. The second part of the duodenum is brought into the wound and packed off. A clamp secures the pylorus and common bile duct. Vertical incisions are made in the anterior wall of the duodenum and end of the bile duct. The wound in the former is shown too large for the sake of clearness.

duodenum thus removing any debris ¹ but if free drainage is established into the duodenum it is not necessary to make a separate incision for drainage of the common bile-duct. A scoop must be passed upwards along the bile duct to prove the absence of stones higher up before the duodenal incision is closed in the usual way with two continuous sutures of fine catgut the wound being drawn transversely to the axis of the bowel before it is closed. A piece of the transverse meso colon is then sewn over the suture line to reinforce it.

¹ Mayo and Kehr

The disadvantages of the operation are :

(1) It is difficult ; but when a stone is impacted near it, the biliary papilla is easy to find.

(2) In two of the sixty-two cases collected by Hancock, a duodenal fistula formed, and in one of these it led to the death of the patient from exhaustion ; in the other the leakage spontaneously ceased. With careful suturing a duodenal fistula should be avoidable.

(3) It has a higher mortality than choledochotomy.

The advantages which have been claimed are that :

(1) Drainage through the cutaneous wound is unnecessary.

(2) It is easier to sew up an intestinal wound than one in the bile-duct.

(3) The intestinal wound heals more quickly and satisfactorily.

(4) The trans-duodenal route gives an easy and natural access to the common bile-duct in its lower part.

(5) The biliary papilla may be enlarged if stenosed.

(6) A new growth or pancreatic stone in the ampulla may be discovered to be the cause of symptoms and may be removed.

This method being more severe and dangerous than opening the bile-duct above the duodenum is, of course, only suitable for cases in which it is found impossible to remove the obstruction in the usual way.

Dr. Hancock¹ has collected the records of sixty-two trans-duodenal operations ; fifty-seven of these were for the removal of gall-stones, three for pancreatic calculi, and in two new growths of the papilla were found. The mortality of the sixty-two operations was 12·6 per cent. and that of the fifty-seven undertaken for gall-stones was 8·77 per cent. The death-rate from this operation will probably be always higher than that of choledochotomy, because the cases demanding it are often later and the operation in itself is more severe. With increasing experience the need of this operation diminishes, the stone being dislodged and backed into the first part of the duct.

Some fifteen years ago I had three cases in which this operation seemed absolutely necessary, but only one since. Two did very well, but the third, a stout man who had been jaundiced over three months, died of hæmorrhage, before the days of adequate methods of preventing it. The following is an account of one of my other cases :

A very stout man, aged 58, with chronic bronchitis, with a history of biliary colic for years. During the last three months he had been rarely quite free from pain and jaundice for more than a few days. While in the hospital he had a shivering fit. He was explored through the usual vertical incision curved inwards at its upper end and dividing some of the fibres of the rectus muscle. After packing the kidney pouch and protecting the stomach and intestines with a large flat pad, a stone was felt at the duodenal papilla. In spite of all efforts to press it back into the first part of the duct, it remained firmly impacted. The peritoneum to the right of the duodenum was incised so that the bowel was liberated sufficiently to allow it to be brought well into view. An intestinal clamp was applied across the first part of the duodenum and the common bile-duct behind it. The stone was grasped between the finger and thumb and pushed well up against the anterior wall of the duodenum, which was incised in a vertical direction directly over the stone, and just above the attachment of the meso-colon. The stone, impacted in the posterior wall of the duodenum, was pressed through the aperture thus made and seen firmly fixed in the

¹ *Loc. supra cit.*

ampulla of Vater, a little of it being visible at the papilla. The mucous membrane covering it was incised upwards along the duct from the orifice, and the stone was easily removed. Then the wound in the anterior wall of the duodenum was closed by a through and through suture of silk, care being taken to place the knots inside the bowel, and, reinforced by a sero-muscular suture of finer silk, a tag of the meso-colon was also sewn over the incision. The suture line was transverse to the axis of the bowel to avoid narrowing the channel. Then the clamp was removed, allowing the gall bladder, which had been distended, to empty itself into the duodenum. It was then opened, but no stones were found in it or in the cystic duct. A tube was sewn into the inverted edges of the wound in the gall bladder, and a large tube containing a wick of gauze was used to drain the kidney pouch, care being taken to place the tube well away from the sutures in the duodenum. The wound was then closed. The patient was kept on water for two days and then the diet was gradually increased. In spite of bronchitis he made a good recovery. Three years later he came to show himself at Out-Patients and was quite well in every way.

Mortality of Operations for Gall stones. This has been greatly diminished during recent years, especially in the hands of surgeons with a large experience of these operations. It must not be forgotten, however, that the average operator does not get nearly such good results as those mentioned below. W. J. Mayo¹ states that "in 1921 the mortality for operation on the common and hepatic ducts was 5.6 per cent. In 1922, by reason of better pre-operative preparation of patients, the mortality dropped to 3.8 per cent for these operations and to 1.6 per cent for 942 cholecystectomies."

The mortality of 2,493 cholecystectomies, performed at the Mayo Clinic between 1907 and 1916, was 1.3 per cent, and that of 2,854 cholecystostomies was 1.5 per cent. Cholecystostomy has become more and more the operation of choice, cholecystectomy being reserved for the graver cases. Of patients submitted to cholecystostomy 53 per cent were cured and of those submitted to cholecystectomy 71 per cent were cured.²

G. W. Crile³ states that, in his own series, "among a total of 1,235 operations upon the gall bladder and gall ducts, the mortality rate has been: cholecystectomy, 2.5 per cent; cholecystostomy, 5.4 per cent. Although these figures make it appear that cholecystectomy is the safer operation, this is due to the fact that cholecystostomy is used in the 'bad risk' cases."

E. S. Judd and J. H. Lyons,⁴ analysing the mortalities of operations upon the biliary passages performed by ten surgeons at the Mayo Clinic during 1922, record no death in 45 cholecystectomies for acute cholecystitis, 1 in 122 cholecystostomies for the same condition, 11 deaths in 890 cholecystectomies for chronic cholecystitis, 2 deaths in 45 cholecystostomies and 1 death in 150 choledochotomies.

W. Martin⁵ had a mortality of 1.7 per cent in 229 cholecystectomies, with complete relief of symptoms in 84 per cent.

Causes of Death after Operations upon the Biliary Passages. The most important of these are hepatic insufficiency, peritonitis, pneumonia, empyema, pulmonary embolism, shock and hæmorrhage.

¹ *Collected Papers of the Mayo Clinic*, 1923, xv, 200.

² C. H. Mayo, *Ibid.*, 1916, viii, 281.

³ *Ann. of Surg.*, 1923, lxxviii, 191.

⁴ *Ibid.*, p. 194.

⁵ *Ibid.*, 1924, lxxix, 424.

CHOLEDOCHOSTOMY

On many occasions a greatly dilated common bile-duct has been mistaken for the gall-bladder and drained, the exact anatomy only being revealed by subsequent operation for closing the biliary fistula or at an autopsy. The mistake shows the great importance of examining the whole biliary apparatus very carefully before deciding upon the exact nature of the operation, but extensive adhesions, a shrunk gall-bladder, the enormous size of the dilated duct or the gravity of the patient's condition may make the mistake unavoidable. Choledochostomy is not a good operation except as a temporary means when it is not justifiable to do more than is absolutely necessary to save life. As a rule the obstruction of the common duct, such as a stone, should be removed, and if this is clearly impracticable either at once or later owing to the nature of the obstruction, either cholecystgastrostomy or choledochenterostomy should be chosen as it saves the patient from a troublesome biliary fistula and the danger of a severe and difficult secondary operation. Moreover, it is easier to perform the anastomosis while the duct is dilated. When the common hepatic duct is obstructed by irremovable carcinoma, life may be prolonged and jaundice corrected by draining the upper part of the duct with the aid of a rubber tube inserted into it.

RECONSTRUCTION OF THE BILE-DUCTS

Choledochenterostomy

Restoration of bile drainage into the intestine when this has become completely arrested may be very difficult and troublesome. Injury to or operations upon the biliary apparatus may so damage or destroy some of the ducts that the bile cannot escape naturally into the duodenum. W. J. Mayo¹ stated before the Surgical Section of the Royal Society of Medicine that in his experience "next to gall-stones in the hepatic and common ducts operative injuries during cholecystectomy are the most common cause for operations on the common ducts." These injuries are chiefly due to lack of experience, skill or care in isolating and dividing the cystic duct and the cystic artery. It is absolutely necessary to identify the cystic duct, common bile-duct and common hepatic duct before attempting to divide the cystic duct, for congenital anomalies of the ducts and of the cystic artery and the alteration and confusion of the normal anatomical relations as a result of inflammation and disease make it easy to injure the ducts. Many kinds and degrees of injury may occur, especially during cholecystectomy, unless the greatest care, skill and patience are exercised.

The most common site of injury is near the insertion of the cystic duct. Any want of definition of this part or traction upon the cystic duct may lead to "button-holing," complete division or even excision of large segments of the common bile-duct and common hepatic duct. An attempt to remove the whole of the cystic duct may easily lead to a lateral wound involving these ducts which may be followed by a stricture at this site. For this reason it is a mistake to try to remove the whole of the cystic duct, it is better to divide it about a quarter of an inch from the common bile-duct.

¹ *Collected Papers of the Mayo Clinic*, 1923, xv, 205.

Another common source of injury to the ducts is want of care in finding and tying the cystic artery and trying to arrest the bleeding with forceps which may crush the ducts and lead to sloughing. Sometimes one of the main ducts has been ligatured and the mistake has not been recognised during the operation.

Apart from definite wounds or injuries, obstruction of the main ducts may result from linking or from compression by scar tissue outside the ducts. Sometimes a true stricture develops as a result of ulceration of the common duct following the long continued impaction of a stone. Innocent or malignant growths of the ducts or operations for their removal present similar difficulties in the restoration of normal bile drainage.

Symptoms and Signs Wounds of the bile ducts are generally detected during the operation but, failing this a biliary fistula usually results or bile may accumulate in the right flank and perhaps cause suppuration. If the fistula closes jaundice, either continuous or intermittent, develops and is often associated with severe colicky pains suggestive of the impaction of a stone in the common bile duct. Fever and rigors may ensue due to infective cholangitis, and biliary cirrhosis, with interference of the hepatic and renal functions accompanied by wasting and anaemia usually follows, so that these patients generally become very ill and bad subjects for operation.

Intermittent attacks of colic associated with jaundice generally suggest that a stone has been left behind in the common bile duct and a stone or debris may actually form in the dilated ducts above the stricture and act as a ball valve in this position. Intermittent inflammatory swelling at the site of the stricture and, sometimes, the formation of projecting granulations may cause temporary obstruction. In some cases an attack of jaundice is relieved by the reformation of a biliary fistula and the patient may remain in fair health as long as the discharge continues.

Indications for Operation If any bile can be shown to reach the intestine, it is generally wise to defer operation in the hope that spontaneous recovery may ensue for a biliary fistula may close spontaneously after many months. It is however necessary to provide free drainage for any accumulation of bile or pus which may otherwise press upon the common bile duct. On the other hand it is important to advise a radical operation when the symptoms are severe and the general health deteriorating, for long continued jaundice, pain and fever with depreciation of the liver function, make a delayed operation extremely hazardous.

Operation

(1) *Immediate Restoration of the Ducts.* Wounds of the bile ducts should be recognised and treated at once, for it is much easier to identify and repair the damage at this stage, before the anatomical relations become obscured and the parts fixed by adhesions and contractions and before the general health and the functions of the liver deteriorate. A "button hole" wound of a duct can be easily closed without narrowing the lumen, for instance, when the wound is longitudinal the suture line should be transverse. Only fine catgut should be used, for stones have formed on silk sutures used for this purpose. When a duct has been completely divided or a segment excised, end to-end union can be carried out and a deficiency of as much as two to three centimetres overcome after mobilising the parts. If there is any fear of a stricture at the suture

line it is wise to insert a rubber tube in the proximal part of the duct and to fix it there with a single catgut suture ; the other end of the tube is passed through the lower part of the common bile-duct and into the duodenum for several inches, after the method of Sullivan and MacArthur. After some weeks or months the tube passes spontaneously into the bowel, the intestinal peristalsis helping in this process.

As a rule the results of these immediate plastic operations are very satisfactory, but it is of the greatest importance to make sure that the lower part of the common bile-duct is not obstructed in any way and, for this purpose, it is wise to pass a large probe through the papilla into the duodenum.

(2) **Secondary Restoration of the Ducts.** Before undertaking this most difficult and dangerous operation it is of vital importance to prepare the patient thoroughly. The chief risks are hæmorrhage and cholæmia. Deficiency of lime in the blood, which is the most important cause of

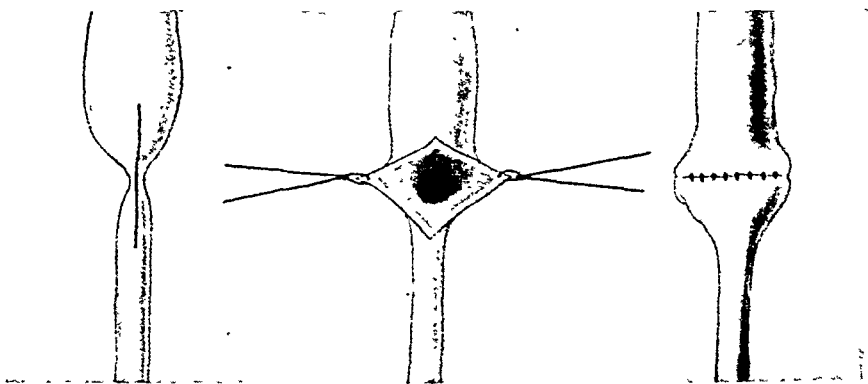


FIG. 259. Operation for stricture of a bile-duct. A longitudinal incision through the stricture is converted into a transverse one.

post-operative hæmorrhage in jaundiced patients, can be made good by the intravenous injection of 5 c.c. of a 10 per cent. solution of calcium chloride¹ daily, for three or four days before the operation ; the coagulating time of the blood should be thus reduced to the normal, but failing success by this method, blood transfusion must be added. Deficiency of fluid and errors of the hepatic function may be made up by the administration of plenty of water and glucose by the rectum or subcutaneously.

As a rule a right high paramedian incision is the best and is especially valuable in avoiding adhesions when any other incision has been used at the primary operation. The difficulty of finding the bile-ducts may be very great owing to extensive and dense adhesions. The duodenum is very carefully separated from the liver and the gall-bladder or, when this has been removed, the gall-bladder notch in the liver is identified and traced backwards and the proximal part of the duct is sought at this point very close to the liver ; it is a common mistake to start the dissection too low down. The dense adhesions are very carefully and slowly

¹ W. Walters, *Collected Papers of the Mayo Clinic*, 1921, xiii, 607 ; and *Surg., Gyn. and Obst.*, 1921, xxxiii, 651.

divided any bleeding vessels being at once ligatured. When it is difficult to identify the bile duct a long fine needle attached to a glass syringe is used to explore the supposed duct. In this way the accidental opening of the portal vein is best avoided.

If the obstruction is due to a stone in the common bile duct (as so often happens) it is enough to remove the stone and prove the passage clear. If it is due to contraction of scar tissue around the ducts this should be carefully excised. If it is caused by kinking resulting from the retraction of a shrivelled gall bladder removal of the latter is sufficient. If a simple annular stricture is found involving the wall of the duct a longitudinal incision through it with careful suturing after the manner of Finney's operation for enlarging the pylorus is very satisfactory.

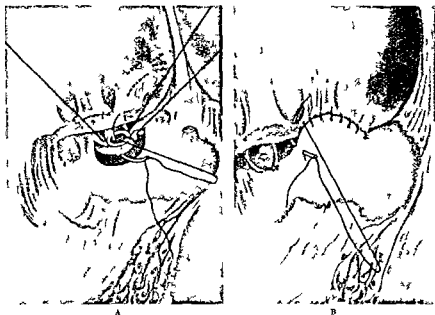


Fig. 2()

In many cases it is quite impossible to find or use the shrivelled lower part of the common bile duct. Moreover the gall bladder is very rarely available for cholecystgastrostomy. Under these circumstances one of the following operations is indicated.

(1) **Mayo's Method** In his original operation¹ Mayo made a direct union between the hepatic duct and an opening of the same size in the duodenum. The result in this particular case was very satisfactory the patient having survived nearly twenty years in good health but in some subsequent cases a stricture formed at the duodenal end of the duct calling for a second operation. This complication led to the evolution of the following operation.²

The stump of the hepatic duct is freed as much as possible from its adhesions but it is rarely possible to secure a projection beyond the

¹ W. I. Mayo *J. of Surg.* 1905 xlii 90

² D. C. Balfour *Ann. of Surg.* 1921 lxxiii 346 and *Surg. Gyn. and Obst.* 1910 xxi 1

liver fissure for more than 0·3 cm. to 0·5 cm. The duodenum, as has been noted, is usually drawn into the same mass of adhesions and it is always wise to avoid separating it posteriorly. If it is separated, a few catgut stitches will draw it up again to the stump of the duct. A slightly curved flap is then dissected out of the entire thickness of the duodenal wall over an area which will leave an opening into the duodenum about 2 cm. in diameter (Fig. 260A). The duodenal flap is then approximated to the posterior and lateral aspects of the stump of the hepatic duct in such a manner as to permit of a mucomucous union of the posterior half of the circumference of the duct, with the edge of the flap sutured as shown in the figures. The opening in the duodenum is, of course, much larger than the hepatic duct. The remaining free margins of the opening in the duodenum are sutured to the capsule of the liver just above the hepatic

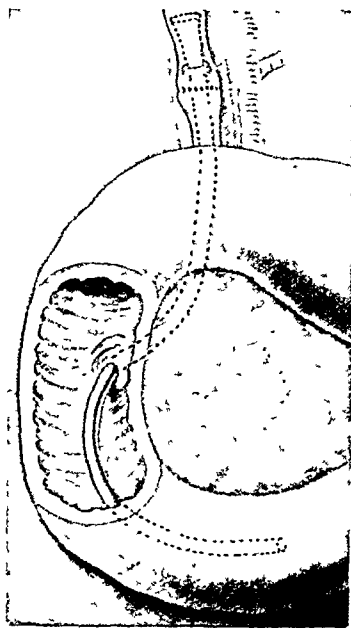


FIG. 261. Anastomosis of the common bile duct with the aid of a long rubber tube projecting into the duodenum. The upper part of the tube is enlarged and has a collar round it to keep it in place.

duct end by a continuous catgut suture so that the under surface of the right lobe of the liver, or more correctly Glisson's capsule and the scar tissue adherent to it, effectually closes the opening in the duodenum not occupied by the end of the hepatic duct. A considerably wider area of the duodenum is then drawn up towards the liver and fixed with catgut sutures. The omentum is caught by the tip and divided if necessary so that it may be used effectually to surround the anastomosed area. Drainage is seldom necessary; if needed two small strips of rubber tissue are introduced, one above and one below the anastomosis. In some cases a moderate amount of bile may escape for a few days. This has always ceased within a week, however, and healing finally has been complete in each case. In no case has there been any evidence of subsequent obstruction to the duodenum, and in no case a failure to deliver bile into the duodenum.

"It will be noted that this technic provides a large opening in the duodenum and a mucomucous union for two thirds or, at least, one half the circumference of the hepatic duct stump. These provisions, together with the method of suturing the opening in the duodenum to the liver, allow for contraction and obviate the danger of secondary stricture, so that obstruction does not take place" (Fig 260B)

(ii) **Anastomosis with the aid of a Rubber Tube.** After careful experimental work on dogs Sullivan¹ describes his technic as follows

"Into the stump of the hepatic duct an elastic rubber tube is inserted for about half an inch and securely sutured to it with several unabsorbable sutures. The other end of the tube is pushed down into the duodenum

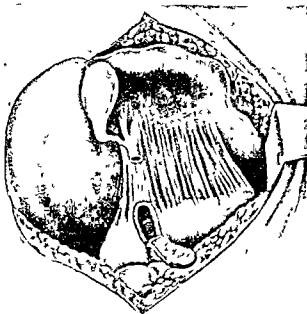


FIG. 262 Choledochoenterostomy (Walton's method). The divided common bile duct and a duodenal flap are shown.

through the stump of the common duct if possible or if this is not possible, the tube should project through a small incision in the anterior wall of the duodenum about one half inch into its lumen.

"The opening in the duodenum should be sufficiently repaired so that the cut edges snugly encircle the tube. At the point where the tube penetrates the intestinal wall the former should be firmly anchored to the duodenum with unabsorbable sutures. The duodenal walls are then sutured over it, so that for a distance of about 2 cm. before the tube penetrates into the intestine, it runs in a canal composed of overlapped duodenum. The tube is then anchored with unabsorbable sutures in several places to the duodenum and the gastrohepatic omentum. In short, the tube is to be put in with the idea of keeping it *in situ* as long as possible. The great omentum is then drawn up and a suitable area is selected with

¹ *Journ. Amer. Med. Ass.*, 1912, LVIII, 2026.

which to cover the exposed surface of the tube. This area is traumatised by drawing a dry sponge over it lightly a few times; similar friction is applied to the duodenum and the gastrohepatic omentum on either side of the tube. The omentum is then placed so as to cover the tube and extend beyond it a centimetre or two in all directions and is carefully anchored in position by several catgut sutures.

"The rubber tube should have a lumen of not less than a quarter of an inch and should be soft pure rubber yet resilient enough to retain its shape. Should the structures into which the tube must be passed not admit one of the calibre, stretching it along a stiff sound or a long-shanked forceps, thus decreasing its diameter, will make it possible to insert it easily."

Sullivan also suggested that a probe should be passed up through the duodenal papilla to make it easier to identify the lower segment of a divided common bile-duct.

McArthur has successfully used this method and makes the following remarks: ¹

"If there be one thing more than another that I desire to emphasise in this contribution to duct repair, it is this: that by the constant duodenal and jejunal 'tug' upon a catheter inserted through the duct or side of the duodenum it will ultimately be drawn into the intestine and discharged per rectum. In the eight cases I have had, the shortest time of discharge has been twenty-seven days; the longest, sixty-three. Hence we have a method of getting rid of a tube without a secondary interference. When, however, it has been deemed necessary to have it remain until the surgeon desires its removal, this has been readily accomplished by tying to the catheter a simple waxed silk ligature, which, brought out through the interval between the ends of the duct being repaired, is carried through a very small rubber tube reaching from the duct to the surface of the body and fastened to an adhesive strip, the small tube covering the thread for its protective effect against cutting of tissues by the thread. When ready to cast off, the anchorage thread is cut at the surface of the skin. Within three to seven weeks the catheter passes off through the alimentary tract, and the cure is completed."

Mr. A. J. Walton's Method. "Exposure is gained by an upper right pararectal incision. . . . It gives an admirable approach and a perfect view. . . . The common bile-duct is now laid bare; if there has been a prolonged biliary fistula, the lower end will probably not be discovered; if there is a stricture or carcinoma, this is removed, if possible, so that there now remains a condition in which the upper end of the duct is patent, but is separated by a wide gap from the duodenum, making a direct implantation impossible. The upper border of the duodenum is now drawn upwards and sutured, so that the gap is as far as possible reduced. The largest size tube that will enter the cut end of the duct is inserted, and sutured in position with plain catgut. A flap is then cut from the anterior surface of the duodenum, and is turned downwards. The upper end of the resulting opening is sutured until it is only sufficiently large to admit the tube. The tube is then inserted, and the flap turned upwards over it. In the upper portion the edges of the flap are sutured around the tube, and to the edges of the cut duct; below they are sutured to the wall of

¹ *Ann. of Surg.*, 1923, lxxviii., 132.

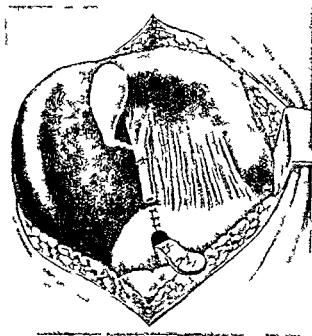


FIG. 263. Choledochenterostomy (Walton's method). A rubber tube has been fixed in the common bile-duct and the duodenal wound has been partly closed by sutures.

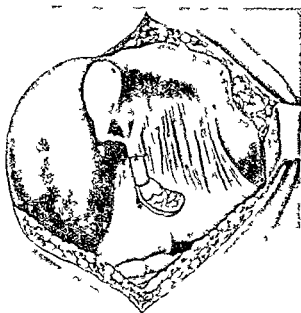


FIG. 264. Choledochenterostomy (Walton's method). The end of the rubber tube has been inserted in the duodenum.

the duodenum which forms the structure adjacent to the posterior surface of the tube. For safety a small drainage tube is inserted down to the junction.

"The operation in practice is very simple to perform. A new duct can readily be formed of practically any length ; it is lined with mucous

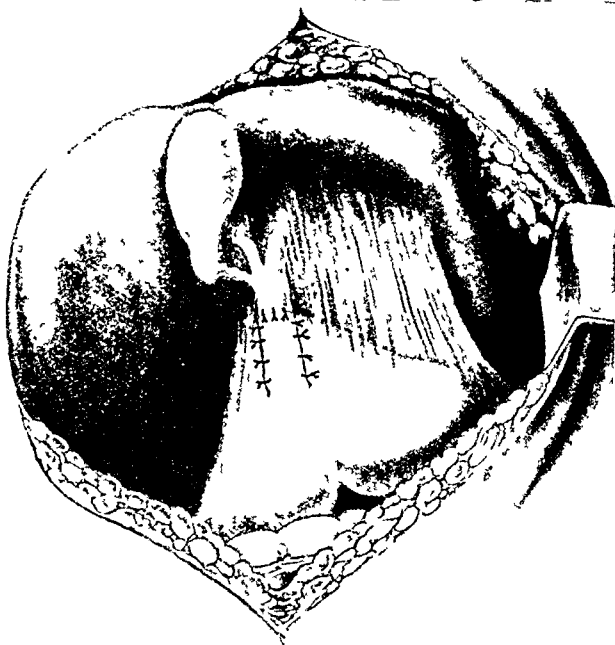


FIG. 265. Choledochenterostomy. The flap has been sewn around the rubber tube.

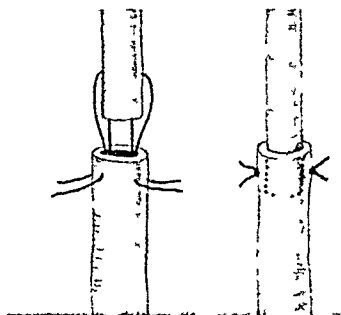


FIG. 266 Reconstruction of a bile-duct. The proximal end is drawn into the distal end by means of two sutures passed as shown.

membrane which is impervious to the action of the bile, and being lined with such a membrane will show no contraction ; the tube passes obliquely over the duodenal surface, and hence there will be a well-defined valvular action. Owing to the presence of the mucous membrane lining it is not necessary for the tube to remain long in position. It can be sutured in place with plain catgut, which is dissolved in a few days, and thus there

is little or no danger of the tube being retained. In the cases already mentioned in which there is an obstruction due to carcinoma or chronic pancreatitis, and in which the duct has been opened for exploratory purposes, so that cholecystenterostomy becomes a risky procedure, it is a perfectly simple matter to insert the tube into the lateral opening in the common duct instead of into the cut extremity, and then to reconstruct the new duct from the duodenal flap round the tube so that there is in fact, a new duct entering the lower part of the original one at a slight angle."

W Walters,¹ after accidentally dividing during cholecystectomy an accessory right hepatic duct, successfully inserted it in the open distal end of the cystic duct.

Prognosis. The mortality of these difficult operations is naturally high and the functional result is not always perfect, for recurrence of symptoms and the need of further operation is common. W J Mayo² states

"In a period of twenty-two years, 104 patients were operated on in our clinic for restoration of function between the hepatic and common ducts and the duodenum with a hospital mortality of fifteen. The late mortality in all the years since the operation was nineteen. Twelve of these late deaths were due to progressive biliary cirrhosis, one to carcinoma of the pancreas, four and one half years after operation, and four to other causes not connected with the operation. Of the remaining seventy patients the present condition of sixty-three is known: forty-five are well, seven in fair health, and eleven continue to have more or less symptoms. A study of the operative methods employed in these cases, from the standpoint of ultimate results, indicates that in any case in which a piece of the duct has been accidentally removed, and the injury not discovered and repaired at the time, thus necessitating secondary reconstruction, direct union between the stump of the hepatic duct and the duodenum is the best operation."

CHOLEDOCHECTOMY

Doyen removed a portion of the common bile duct which had been torn across during the removal of a stone. He pared the frayed edges and joined them together over a rubber tube inserted in the duct, the end of the tube should project into the duodenum for at least half an inch. Kehrer resected a simple stricture of the duct and joined the latter by suture except for an opening in front, into which a tube was inserted for drainage. Moynihan performed a similar operation for a malignant stricture, but the patient died of recurrence in the portal fissure within three months.

Mr Upcott³ records two cases of carcinoma of the ampulla of Vater and reviews the literature. He found sixteen recorded resections of the tumour including his own case. In thirteen the transduodenal route was adopted with eight recoveries, and in three a segment of the duodenum was removed with two recoveries. The following is quoted from Upcott's own account of his operation:

"Nothing was felt in supraduodenal part of common duct, but at the

¹ *Collected Papers of the Mayo Clinic*, 1923, xv, 209.

² *Collected Papers of the Mayo Clinic*, 1923, xi, 200.

³ *Ann of Surg*, 1912, lvi, 710.

lower end of the common duct in the posterior wall of the duodenum was felt an oval mass the size of a large olive. This was movable, but could not be pushed up above the duodenum, it had a clearly defined outline and was of firm consistency, but did not feel as hard as a stone.

"The duodenum was mobilised and its anterior wall incised transversely over the mass, which was then readily projected through the anterior incision. It appeared as an oval projection with its long axis coinciding with that of the duodenum and covered with the mucous

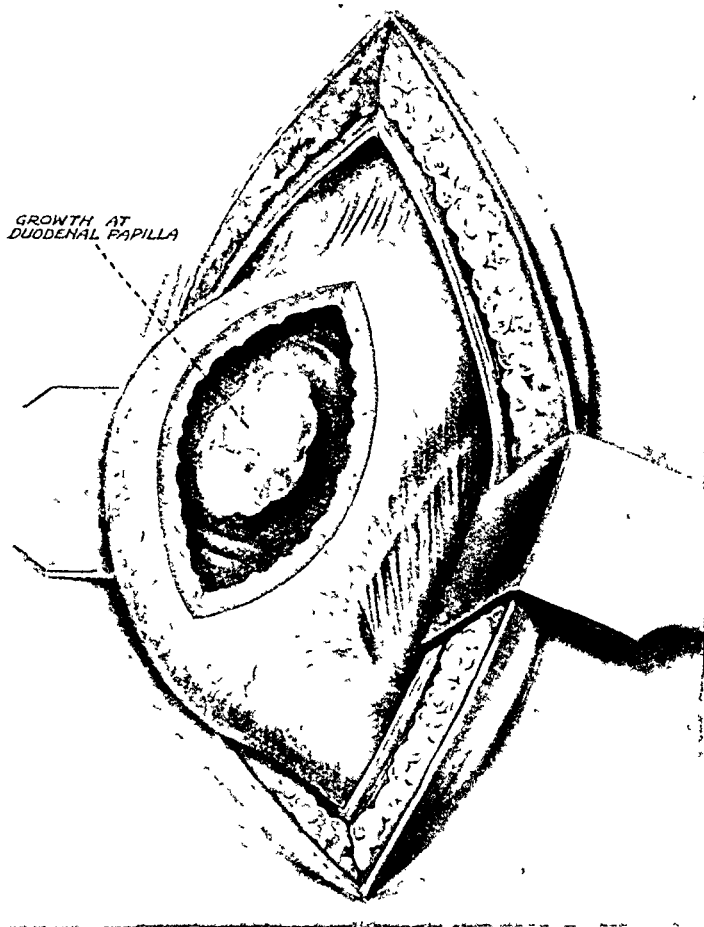


FIG. 267. Cholecystectomy. A growth is shown at the duodenal papilla.

membrane of the posterior wall. On its most prominent part was the stretched opening of the ampulla. It was readily lifted away from the tissues posteriorly. A small cut was made into the mass, exposing a pale, bile-stained tumour substance (see Fig. 267).

"The mucous membrane was incised around the tumour, which was then drawn forward and cut away. A quantity of turbid mucus escaped from the divided end of the common duct. A small, oval, unfaceted stone was removed from the upper end of the common duct. The cut edges of the dilated bile-duct were sutured to the margins of the mucous

membrane The cut end of the pancreatic duct could not be identified in the wound, so the lower part of the incision was not sutured The anterior incision in the duodenum was closed by suture Further palpation of the common duct showed a palpable lymph node a little way above the duodenum and a firm mass of several nodes in the gastrohepatic omentum just to the left of the hepaticocystic confluence The gall bladder was drained and the abdomen closed The patient aged 65, made a good recovery and rapidly gained weight "

The tumour is generally a slow growing columnar celled adeno carcinoma It causes obstruction quite early and usually causes death in this way before the lymphatic glands in the portal fissure become infected, or dissemination occurs An exact diagnosis is very rare until the abdomen is opened, and even then the tumour may be mistaken for stone Cholecystenterostomy may prolong a patient's life for a long time up to two years but a radical operation should be attempted whenever possible This may be done in one or two stages palliative drainage being done at first The commonest method of resection has been well described by Mr Upcott (*vide supra*) The alternative method is by "circular resection of the duodenum followed either by axial anastomosis or by closure of the cut ends and gastro enterostomy The passage of the bile may be provided for by implantation of the common duct into the bowel or by cholecystenterostomy " Mr Upcott believes "that the simpler operation of transduodenal excision will prove the best for most cases of cancer of the ampulla If the growth is too extensive to be removed in this way a palliative operation will be preferable to the formidable resection advocated by Kausch " ¹

CHOLECYSTGASTROSTOMY

In this operation a communication is made between the gall bladder and the stomach Formerly the gall bladder was anastomosed to the duodenum, jejunum or transverse colon, but it is easier and safer to divert the bile into the stomach, where it does little, if any, harm ² On the other hand, joining the gall bladder to the duodenum may be very difficult owing to adhesions, and there is some danger of duodenal obstruction or fistula Kinking with severe vomiting sometimes followed the anastomosis of the gall bladder to the jejunum When the bile is diverted into the colon any digestive value it may possess is lost and infection of the gall bladder and bile ducts is likely from the contents of the colon

For these reasons I prefer to join the gall bladder to the stomach and have found the results much better

Indications (1) Irremediable obstruction of the common duct, due to calculus, cicatricial contraction or growth of the duct The operation should be rarely required for calculous obstruction, for it is much better to remove the stones if possible In some cases this may not be practicable or the condition of the patient may make the attempt inadvisable Leaving the stones may lead to suppurative cholangitis or to the development of malignant disease

(2) Irremovable obstruction of the cystic duct with mucocoele or mucous fistula, where cholecystectomy is impracticable

¹ *Zend f Chir*, 1909, xxxvi, 1352

² Penier, quoted by Moynihan, *Abdominal Operations*, 1918, 3rd edition, ii, 335

(3) Persistent biliary fistula after operation on the gall-bladder or due to stricture or occlusion of the common duct. In such cases this operation is often easier and safer than making an attempt to restore the natural passages.

(4) Chronic pancreatitis with jaundice from compression of the common bile-duct. For this condition the operation is very successful.

(5) Malignant disease about the head of the pancreas, occluding the common duct and giving rise to jaundice, itching, etc. Irremovable growth of the common duct or ampulla of Vater may be added. In such cases cholecystgastrostomy must involve increased risk. Hæmorrhage and imperfect repair are the chief dangers, the first especially so, but with early operation these dangers are not so great.

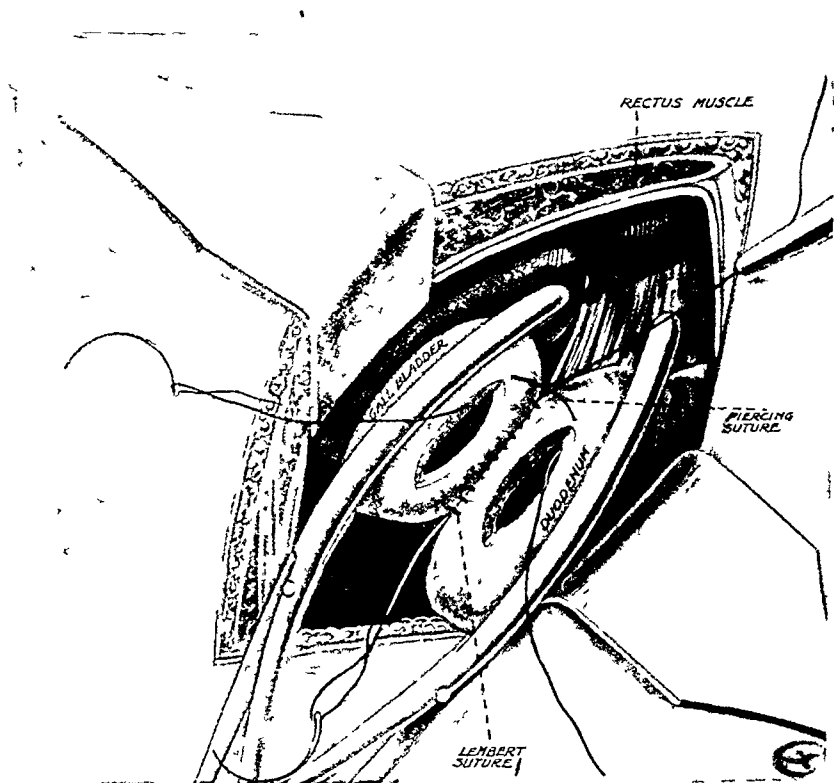


FIG. 268. Cholecystoduodenostomy.

(6) Injuries, especially division, of the common bile-duct, when the natural channel cannot be restored.

Operation. A vertical right paramedian incision is made in the epigastrium, close to the middle line, so as to avoid bleeding—an important point in these cases. Packs are carefully placed and a lumbar cushion is used. The gall-bladder, when distended, is first emptied by aspiration and then joined to the stomach with the aid of curved clamp forceps and two continuous sutures, as in the operation of gastro-jejunosomy (see Fig 269). The opening into the stomach is made on the anterior wall, two inches from the pylorus, so that the latter may not be interfered with

in any way. The aperture should be made at least an inch long. Fine catgut is the best material for both sutures. The clamps are removed as soon as the deep suture is completed—the gastric one first—for this makes it easier to complete the serous suture, especially when the gall bladder is small, adherent or deeply placed.

Objections to the Operation. For suitable cases it is a splendid operation, but

(1) It has often been adopted when the cause of obstruction should have been removed and a cure obtained instead of mere palliation.

(2) Another objection, though only proved by a few cases is that of septic infection of the ducts and liver from the stomach or intestine. There is less risk of infection when the fistula is made into the stomach.

(3) After this operation the bile is diverted through the cystic duct

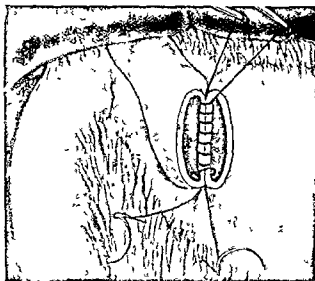


FIG. 269. Cholecystgastrostomy. The gall bladder is joined to the stomach well to the left of the pylorus.

and gall bladder into the stomach. The gall bladder takes on itself the function of the common duct, and the common duct, remaining patulous at its upper end, receives a certain amount of bile which stagnates under conditions which favour its crystallisation, especially if, as is often the case, the common duct is unhealthy.

TREATMENT OF BILIARY FISTULA

Biliary fistulæ may be either (a) external or (b) internal. They may also be either spontaneous or post operative.

(a) *External or Cutaneous Biliary Fistula* is generally due to some obstruction to the biliary passages by impacted stone, stricture, valve formation either congenital or post operative, innocent or malignant growths of the bile duct or growths pressing upon it. Sometimes a fistula is due to an error of technique during an operation, for instance, a short gall bladder fixed to the parietal wound may by traction kink the junction

of the hepatic and common ducts, with the result that all the bile is diverted through the gall-bladder to the surface.

Biliary fistulæ are much rarer than they were some years ago, when stones were more commonly left in the common duct. The same is true of biliary or mucous fistulæ due to stone or other intermittent or permanent obstructions of the cystic duct or neck of the gall-bladder. Similarly the far more frequent choice of cholecystectomy instead of cholecystostomy has greatly reduced the number of biliary fistulæ. D. C. Balfour and J. W. Ross¹ point out that biliary fistulæ are preventable because they are largely due to "surgical inexperience, inadequate exposure, hurried operation, incomplete or careless exploration, failure to remove the gall-bladder, accidental injuries to the ducts and unintelligent use of drainage."

Indications for Operation. Although a biliary or even a mucous fistula is very annoying it may continue for many months or even years without doing much harm; but if all the bile is lost, the patient ultimately becomes anæmic and may even bleed from the gums and elsewhere and, as there is little hope of spontaneous closure in these cases, an operation is indicated after six weeks. If some bile reaches the bowel there is more hope in waiting. Attacks of colic with fever indicate early operation.

Operation. Sometimes syringing through the fistula may dislodge a stone and cure the fistula, but as a rule the abdomen has to be opened internal to the fistula and the biliary apparatus thoroughly explored. Any obstruction found is removed if possible. Failing this the gall-bladder is detached from the parietes and anastomosed to the duodenum, stomach or, in some cases, to the colon. In some cases of kinking following operation it is best to remove the gall-bladder after proving the way clear by passing a probe along the common duct into the duodenum. A biliary fistula following cholecystectomy, with injury of the common bile-duct, common hepatic or right hepatic duct, may be extremely difficult to cure, especially as dense adhesions and stricture are apt to follow. Great care is necessary to avoid these injuries, but if they occur they should be recognised and treated at the time of the primary operation or very soon afterwards if the condition of the patient does not allow the necessary prolongation of the operation. It is much easier to find and to close accidental wounds of the ducts at this time, before suppuration and adhesions obscure the view and cause secondary deformities, which are very difficult to correct. Sometimes a biliary fistula, following operation, closes spontaneously after many months, so that, if any bile reaches the intestine it is often wise to wait for some six months, especially if the cause of the leak is uncertain and the general health is not deteriorating. When a mucous fistula persists, cholecystectomy is indicated or, failing this, the mucosa may be shelled out from a mass of adhesions, or a stone in the cystic duct may be removed.

The following case, operated upon by one of us (R. P. R.), illustrates some of the difficulties that may be met:

"*Stone Impacted in Polypoid Duodenal Papilla: Cholecystostomy: ? Pancreatic Growth: Biliary Fistula: Cholecystectomy: Choledochotomy: Recovery.* The patient, a medical man aged 67, kindly wrote the following account of his symptoms:

"*Family History.* Father never ill until age of 65, when he had a severe illness, at first thought malignant, but was no doubt due to gall-bladder. He was not

¹ *Collected Papers of the Mayo Clinic, 1921, xiii, 170.*

jaundiced. I a student at the time examined faces for gall stones but found none. He completely recovered for seven years and then after a long walk died of hæmorrhage from the stomach in twelve hours. I was then abroad. Father's brother a healthy man was treated for gall stones at the age of 43. Recovered and died at 74. Mother died at 85.

Personal History. Born 1852 never robust but seldom laid up. Had typhoid badly in Argentina at the age of 20 and malaria badly in Persian Gulf at age of 24. Came home and malaria disappeared. Always lived a moderate life.

History of Present Illness. About five and a half years ago after about twenty-four hours dull pain in the back. I became slightly jaundiced which lasted a few days. I had about two similar attacks in four years up to March 1918. During this night (March 21st 1918) I awoke at 1.30 with a strong rigor lasting twenty minutes. No pain resembled malaria but without subsequent sweating. The day before this I had felt some malaria and discomfort in the back. Slightly jaundiced next day which went off in four days time. Day after attack motored twenty-one miles and sat on Recruiting Board. Got home very weak in afternoon. Went again next day but could scarcely eat my lunch. Kept on the same for five days but then awoke in the night with severe rigor and high temperature (104° or 105°). Staved in bed three days, and symptoms including jaundice gradually subsided but felt very weak. For some months before this attack was conscious of tenderness over gall bladder which was always improved by doses of castor oil even before bowels responded. Weight (stripped) after attack 8 st. about three or four years before about 10 st. Went into a nursing home July 1918. Had a rigor the first night there and about every six days. Was operated on after about three weeks and 1 three small gall stones removed. I noticed that the first two motions after operation contained bile but no bile in the subsequent motions. Came home about a month after the operation. Nearly all bile came through sinus in wound and I was slow in picking up strength. Had three or four loose motions every day with ravenous appetite for the six months until the second operation. There was occasionally a streak of darker colour in the almost uniformly pale motions.

Second Operation. I saw the patient for the first time in January 1919. At the first operation the pancreas had been lard and malignant disease was feared but the patient's general condition improved and he put on some weight during the next six months but his biliary fistula became very irksome. When I saw him all the bile escaped at the biliary fistula and the patient was still thin and in a bad state of nutrition. He was willing to undertake any risk in order to get rid of the fistula.

The lips of the fistula were separated and clamped to avoid spilling of bile infecting the wound and also to maintain the pressure inside the ducts. Kocher's incision was adopted. A vertical incision had been used at the first operation. The gall bladder was very large the common bile duct was distended no stone could be felt at first but later on feeling the third part of the duodenum a large stone was felt evidently at the end of a very much elongated bile duct or pedunculated papilla. With some difficulty the pedunculated part of the duct was steadied with one hand while the stone was squeezed back into the duct with the other. In this way the need of opening the duodenum was avoided and the stone then extracted from the first part of the common duct. In order to avoid recurrence the ducts having been proved to be clear the gall bladder was removed and the common bile duct drained. The stone was the size of a filbert. The patient wrote on March 1 1920 stating that

Since my second operation there has been no looseness of bowels and the appetite became very moderate. The motions are always uniformly stained dark brown with bile. Unless the gall bladder has some beneficial secretion of its own—I have only heard of mucus—I think we should be better without it.

Prostatectomy was performed later and he was very well in 1920.

Balfour and Ross¹ reviewed 166 cases of biliary fistulae seen in the Mayo Clinic between 1909 and 1920. Ten per cent of these patients died as a result of attempts to cure the fistula, the deaths occurred chiefly in the cases of division or stricture of the common or hepatic duct.

¹ *Loc. supra cit.*

(b) **Internal Biliary Fistulæ** may form between the gall-bladder or bile ducts and any neighbouring or even distant hollow viscus when the gall-bladder is either abnormally placed or greatly dilated. Nearly always fistulæ are the results of inflammation with adhesions and ulceration due to gall-stones, although occasionally they may be due to malignant disease or operation.

The commonest internal fistulæ are between the gall-bladder or common bile duct and the duodenum, stomach or colon. Often they do not call for interference, for they either heal spontaneously after the stone has passed, or they cause no serious harm. For instance, an old lady had a fistula between the gall-bladder and the colon discharging most of the bile unaltered by the anus, sometimes without any admixture of fæces. After three months the fistula closed spontaneously. The stone which probably caused the fistula was never noticed in the fæces.

When a fistula is discovered during an operation, and if it interfere with a satisfactory examination or treatment of the biliary apparatus, the adherent viscera should be detached, the edges pared and each opening closed with two continuous sutures in the usual way; but before doing this it must be clear that the bile can reach the bowel through the natural passage.

CHAPTER XXII

OPERATIONS ON THE PANCREAS

INTRODUCTION

FOR a knowledge of these diseases we are largely indebted to Senn, Fitz Opie, Mikulicz¹ Mayo Robson,² Deaver³ Archibald⁴ and Mann⁵ who have done brilliant work in establishing the diagnosis and treatment of diseases of the pancreas upon a sound basis. Placed deeply in the abdomen and surrounded by structures of great importance this organ was long considered to be beyond the reach of surgery but more accurate knowledge of the pathology of the pancreas and of the special surgical principles which must be observed to attain success in this branch of surgery, has already done much to change our views and recent results show that the future is full of promise.

We owe much to Professor Mikulicz for pointing out the best ways of dealing with the peculiar dangers and difficulties which attend operations upon the pancreas.

Difficulties and Dangers and the Methods of meeting them. (a) *Diagnosis* The position of the pancreas makes it very difficult for us to feel and recognise any enlargement of it unless the patient is very thin or the abdominal wall relaxed under the influence of an anæsthetic.

The functions of the organ are not influenced very much until the disease is too advanced or extensive for successful surgical treatment to be undertaken. Systematic examinations of the urine⁶ and of the feces provide us with earlier indications of functional changes and enable us to arrive at a diagnosis or to explore earlier than heretofore. Until recently wounds and contusions of the pancreas were more serious than those of any other abdominal organ. The chief reasons for the high mortality were (a) the low condition of the patient at the time of the operation, owing to delay in diagnosis, (b) hæmorrhage and the difficulty of arresting it, (c) escape of pancreatic secretion into the peritoneum, (d) concomitant injuries.

(b) *Hæmorrhage* The pancreas is friable and its vessels thin walled and very numerous, so that it is difficult to stop bleeding from it. It is impossible to catch the individual blood vessels with artery forceps in the usual way and ligatures often do not hold but tear through the delicate tissues and blood vessels. It is best to suture any wounds or lacerations with stout catgut, which must take a good bite and must not pierce the ducts or be drawn too tightly. Gauze packing is usually successful. Hæmorrhage is not only serious in itself, but the blood also forms with the pancreatic juice an excellent culture medium for bacteria.

¹ *Ann of Surg*, 1903, xxviii, 1.

² *Hunterian Lectures, Lancet*, 1904, i, 773, 845 and 911.

³ *Surgery of the Upper Abdomen*, 2nd Ed.

⁴ *Surg, Gyn and Obstet*, 1919, xxviii, 529.

⁵ *Amer Journ Physiol*, 1918, xlv, 572.

⁶ *Cambridge, Lancet*, 1904, i, 782.

(c) *Escape of Pancreatic Juice* and exudation from the injured and inflamed gland into the peritoneal cavity is a very serious catastrophe, which almost inevitably leads to peritonitis, whether the contaminating fluid is originally infective or not. The pancreas is very easily infected from the common bile duct, which often contains infective material owing to the obstruction at the ampulla of Vater, which is frequently the cause of the pancreatic disease. Every effort must therefore be made to prevent any leakage of the pancreatic exudate into the peritoneal cavity. This can be done by providing free anterior drainage or, in some cases, by suturing the peritoneum over the pancreas and establishing posterior drainage. It is dangerous to let the fluid escape and burrow in the retro-peritoneal tissues for infective cellulitis may result. Moreover, the pancreatic juice dissolves the clots in and around the severed blood-vessels and restarts hæmorrhage. It is essential, therefore, to drain away the fluids from the injured or diseased pancreas and failure to do this has almost always led to disaster.

The danger of wounding the pancreas during operations is shown by the fact that many years ago out of 30 resections of the stomach in which the pancreas was wounded either accidentally or intentionally the mortality was 70 per cent., whereas the death-rate of 91 resections without any injury of the pancreas was 27·5 per cent. The difference could not be entirely or even chiefly due to the more extensive or later disease, for the deaths mostly occurred not from shock, but from peritonitis, which was doubtless due to the escape of pancreatic secretions into the peritoneum (Mikulicz).

Various Methods of approaching the Pancreas. There are several ways of reaching this deeply placed organ, and they may be conveniently divided into anterior and posterior.

The anterior route allows a far more thorough exploration, but the posterior provides the best drainage in some cases and carries less risk of peritoneal infection from escaping pancreatic secretions.

The Anterior Route. The abdomen having been opened in the middle line between the umbilicus and the ensiform cartilage there are several ways of exposing the pancreas. Often the surgeon has no choice, for a swelling, such as a cyst or abscess, has already approached the surface either below or above the stomach, and the surgeon should then abide by nature's decision. When little or no swelling exists much may depend upon the mobility and position of the stomach.

(a) *Through the gastro-colic ligament* (see Fig. 270). This should be picked up and incised below the greater curvature and the vascular arch that lies beneath it. The lesser sac having been opened, the anterior surface of the pancreas can be examined after displacing the stomach upwards.

(b) *Through the gastro-hepatic omentum.* A transverse incision is made through this membrane, where it is thin above the vascular arch, and to the left of its thick right border which includes the portal vein, hepatic artery and common bile duct. When the stomach is drawn downward, the pancreas can be explored with ease.

(c) *Through the transverse mesocolon* after displacing the colon upwards as in gastro-jejunostomy. This method does not give such a good view or so direct an approach and, lastly, it is unfortunately placed for estab-

movable, was brought to the parietal peritoneum after replacing the sutured stomach. In such a case it would be far better to aspirate the cyst below or above the stomach, and then to bring the lax cyst wall to the surface or, failing this, to fix a tube in it with a purse-string suture.

The Posterior Route. Either an oblique or a vertical incision may be made in the left loin. The vertical incision should be parallel and a little external to the outer border of the erector spinæ, as advised by Mr. Cathcart. An oblique incision closely resembling the one employed in nephrolithotomy may be used.

INJURIES

The pancreas is not often injured because of its deep and protected position, but when it is damaged, either from contusion or penetration, other organs are very frequently affected at the same time.

When the abdomen is explored, under these circumstances, pancreatic lesions are very apt to be overlooked, with fatal consequences. It is important, therefore, to examine this organ before completing all explorations for injuries of the upper abdomen.

Apart from wounds, it will be a rare event for a correct diagnosis to be arrived at before the abdomen is opened for signs of internal hæmorrhage, abdominal tenderness and rigidity indicating peritoneal irritation of uncertain cause, but demanding immediate attention. In a few cases a swelling may appear in the epigastrium, and occasionally there is glycosuria.

When an injury of the pancreas is suspected the abdomen should be explored through an incision at or near the middle line, so that the other viscera may be examined also. Blood may ooze from the lesser sac of peritoneum or areas of fat necrosis may draw the attention of the surgeon to the pancreas, which he may then find to be enlarged from hæmorrhage.

The gland may be approached either through the gastro-colic ligament, small omentum or transverse mesocolon.

Hæmorrhage must be arrested by sutures, ligatures or gauze packing, and free drainage must be established either anteriorly, posteriorly or both ways. When the peritoneum can be sewn over the damaged organ this should be done, but this does not abolish the need of drainage, at least through the loin.

In cases of wounds from behind, it is only necessary to explore the abdomen when signs and symptoms of penetration of the peritoneum manifest themselves; but the patient should be carefully watched, so that abdominal section can be undertaken immediately if any indications arise.

Gunshot wounds are generally penetrating and inflict injuries upon neighbouring organs, such as the stomach, colon or small intestine. They were nearly always fatal during the Great War.

Mikulicz collected 45 cases of injury of the pancreas, 21 penetrating and 21 subcutaneous lesions. Of the former 12 were gunshot wounds of which 5 were treated by operation, with 3 recoveries; 7 were not operated upon, and all of these died.

Out of 9 stab wounds only 2 penetrated the peritoneum; no drainage was employed in one of these, who died; the other recovered notwithstanding multiple intestinal perforations.

All of the 7 with retro peritoneal stab wounds recovered, but in several of these the gland had prolapsed into the wound without being seriously damaged

In some cases the tail may be resected after ligation or suture of the gland near the line of section to prevent hæmorrhage

Out of 24 subcutaneous injuries no operation was undertaken in 13, all of these patients died but as death was the means of the discovery of the lesions, it is probable that some patients recover from slight subcutaneous injuries Of 11 treated by operation 7 recovered

It is significant that out of 12 operations for various injuries drainage was employed in 8, with 6 recoveries, and that the 4 cases in which drainage was not considered necessary ended fatally

Dreifuss² reports a successful operation for rupture of the pancreas and mentions 23 recorded cases with 16 operations and 11 cures, and 7 cases not submitted to operation, all fatal

Dr Randall³ successfully operated on a man æt 48, who had been injured in the epigastrium by the pole of a van which jammed him against a stationary van The operation was undertaken six hours after the injury, on account of gravity of the collapse the site of injury and dulness in the right flank The abdomen was opened above the umbilicus and much clotted and fluid blood was removed A large tear was found in the small omentum and another in the posterior wall of the lesser sac, through which a laceration two inches long was discovered in the body of the pancreas, and the aorta was felt in the floor of the wound, which was sutured with four silk stitches There was not much trouble from hæmorrhage Drainage was established, and the peritoneal cavity cleansed and irrigated The man ultimately recovered completely, although he had troublesome mental symptoms for a time and developed a ventral hernia at the site of drainage

ACUTE HÆMORRHAGIC PANCREATITIS: ACUTE GANGRENOUS PANCREATITIS

This is an acute inflammation of the pancreas, usually associated with and sometimes arising from profuse interstitial hæmorrhage, and either terminating fatally in a few days or subsiding into subacute or chronic pancreatitis Sometimes suppuration or even extensive gangrene of the pancreas may occur Often there is a history of gall stones and, in some, stones are actually found impacted low in the common duct at the time of the operation or upon post-mortem examination Sir Hugh Rigby and Lieut Colonel Nevis, I.M.S.,⁴ have each published a case of pancreatitis in which a round worm was found in the pancreatic duct

Deaver⁵ believes that acute pancreatitis is due to direct lymphatic infection from the gall bladder

The first accurate account of this rare disease was given by Fitz⁶ Since then a number of cases have been recorded by various observers

The chief symptoms, as summarised by Fitz, are "sudden, severe, often intense epigastric pain, without obvious cause, in most cases followed by nausea, vomiting, sensitiveness, and tympanitic, but sometimes dull, swelling of the epigastrium There is prostration, often extreme, frequent collapse, low fever and a feeble, slow at first but soon quickening, pulse

¹ *Semaine Med*, November 18, 1908

² *Lancet*, 1905, i, 291

³ *Brit Journ Surg*, 1923, x, 419, 421

⁴ *Journ Amer Med Assoc*, July 16, 1921

⁵ *New York Med Record*, 1889

Obstinate constipation for several days is the rule, but diarrhoea sometimes occurs. If the case does not end fatally in the course of a few days, recovery is possible, or a recurrence of the symptoms in a milder form takes place, and the characteristics of a subacute peritonitis are developed."

Cyanosis of the face with a general lividity is also a striking sign, and this is associated with noisy, hurried and difficult breathing. Slight jaundice is sometimes seen, and often there is impaired resonance from effusion in the flanks. Vomiting is an early symptom. Deep tenderness and rigidity in the epigastrium are very suggestive. In many cases there is an excess of diastase in the urine and, in a few, transient glycosuria is noticed. Sir Gilbert Barling,¹ however, has shown that the islands of Langerhans are not often seriously damaged.

At first very few cases were correctly diagnosed, the majority, as will be readily understood by consideration of the above-mentioned symptoms, having been thought to be biliary colic, acute peritonitis (especially that due to perforation of a gastric ulcer), appendicitis or acute intestinal obstruction, usually the latter. But the symptoms are so characteristic that an early and correct diagnosis should be made in nearly every case.

Occasionally the presence of an epigastric tumour has materially aided the diagnosis; such cases have been recorded by Thayer,² Pitt,³ and others. In Thayer's case, abdominal section revealed the presence of an abscess in connection with the pancreas, drainage of which resulted in recovery. In Newton Pitt's case, the tumour was chiefly due to blood effusion in and around the pancreas.

Operation. A right paramedian incision is made in the epigastrium, the rectus being displaced outwards. Should a laparotomy be performed on a patient supposed to be suffering from acute intestinal obstruction or acute peritonitis with a negative result, the possibility of acute pancreatitis must be considered. The following points will be found useful under such circumstances:

(1) *Fat necrosis* may be present. This occurs in the form of small patches, circular or oval in shape, and of an opaque white or yellow appearance, scattered about the fat over the pancreas, the omentum and the mesentery. If, on careful inspection with a good light, evidence of fat necrosis is found, it may be inferred that some serious lesion of the pancreas is present. Absence of fat necrosis, on the other hand, does not exclude the possibility of acute pancreatitis.

(2) *Peculiar blood-stained fluid* is found within the abdominal cavity or may be seen through the gastro-colic omentum.

(3) *Swelling of the pancreas on palpation.* This may be due to inflammatory exudation, blood effusions or a collection of pus. In order to examine the pancreas, it must be approached either through the small or great omentum, whichever is found to be the more convenient; generally the incision is made in a bloodless area of the gastro-colic ligament. It is then found to be greatly swollen, soft and of a purplish colour.

¹ *Brit. Med. Journ.*, 1923, i, 705.

² *Amer. Journ. of Med. Sci.*, ex.

³ *Clin. Soc. Trans.*, 1899, xxxii, 71.

The peritoneal and fibrous coverings of the swollen gland are incised in the direction of its long axis with due regard to the large blood vessels. Effusions and clots are mopped away and hæmorrhage is arrested by ligatures, sutures and, if necessary, by packing with a long strip of gauze. The edges of the incision in the omentum are sewn to the parietal peritoneum, and free drainage of the lesser sac is established with large rubber tubes, around which the parietal wound is closed. In all cases a gauze roll is passed down into the pelvis to mop up the effusion there, while the pancreas is examined. If necessary the pelvis is drained with a tube inserted through a stab wound above the pubis.

Mayo Robson recommends that the gall bladder and bile ducts be examined and that if a calculus be discovered at the ampulla it should be removed if the patient's condition allow or if not, that a cholecystostomy be performed, with the object of providing a vent for the retained and infective contents of the biliary and pancreatic ducts. Deaver also supports this view, and he drains the common bile duct directly if the cystic duct is obstructed or the gall bladder is not available.

Opie and Mayo Robson have shown that regurgitation of septic bile into the pancreas is at least a common cause of acute pancreatitis. But the condition of the patient is rarely such as to allow any radical operation, such as cholecystectomy and it cannot be said that even cholecystostomy is necessary for recovery although it may contribute towards it, if done without unduly prolonging the operation. Cholecystostomy should be performed if the gall bladder is inflamed or contains stones, but radical operations are best deferred until the patient has recovered from his acute peril.

Owing to the extremely serious condition that the patient is usually in, every possible precaution must be taken to avoid shock, and the operation itself must be performed as rapidly as possible. It is necessary to continue drainage of the lesser sac for many days or even weeks in bad or late cases, for sloughs gradually separate and repeatedly escape so that, if the wound is allowed to close too soon, it may have to be reopened again to let out pus and sloughs. The discharges are often very irritating therefore the skin must be protected by sterilised vaseline which, unlike the oils and fats in many ointments, is not digested by the escaping pancreatic juice.

For a long time acute pancreatitis was regarded as inevitably fatal, so that when it was discovered during an exploration no attempt was made to deal with the pancreas directly. In some cases, however, peritoneal drainage alone was attended with success.

Dr Muspratt¹ was the first to treat this disease rationally on Dec. 2, 1902, and his surgical instinct and courage were rewarded by the recovery of the patient.

The patient was a woman, 40 years of age, who, after years of abdominal suffering, was suddenly seized with severe pain in the abdomen, attended by collapse and persistent vomiting. Laparotomy was performed within twenty-four hours, and a swollen, tense, and purple pancreas discovered. A free incision was made into its head and free hæmorrhage followed, but this was checked after some trouble, a gauze drain was inserted, and the patient rapidly recovered.

Dr. Porter, of Boston, soon afterwards operated successfully upon the same lines on Feb. 17, 1903.¹

Interesting cases are recorded by Judd,² Ransohoff³ and Deaver.⁴

Prognosis. Without operation the chances of recovery are very small, but with *early* operation there is a fair prospect of recovery. Korte⁵ found that of 21 cases operated upon before the stage of necrosis 16 recovered, whereas out of 13 cases with necrosis of the pancreas only 2 recovered.

Mikulicz analysed the records of 75 cases of operations for acute pancreatitis, of 37 of these in which the pancreas itself was involved in the operative interference, 25 recovered. Of 41 where the pancreas was not tackled, 4 recovered with peritoneal drainage, and after cæcostomy for paralytic distension in one case (Henle).

Sir H. J. Waring⁶ and H. E. Griffiths recorded 15 cases treated during the last ten years, with 7 recoveries. Dreesman analyses 118 reported cases treated by operations with a mortality of 55 per cent., and of 40 cases treated by tamponade of the pancreas only 20 per cent. died.

If all the cases were published the results would not be so favourable, but every recovery means a life saved, for few, if any, patients ever recover spontaneously from acute pancreatitis.

It has been suggested that the operation should be deferred until the subacute stage of the disease, but this is inadvisable, for the large majority of the patients, if untreated, die in the acute stage, and only the milder cases ever reach the more favourable subacute stage of suppuration.

SUBACUTE PANCREATITIS

Here the inflammation is less acute from its commencement, and the patient survives long enough for suppuration or gangrene to occur. The abscess may burst into the stomach, colon, duodenum or peritoneum, or it may reach or bulge forwards into the epigastrium or umbilical region, or backwards into the loin generally on the left side.

Spontaneous recovery may occasionally occur from rupture into the alimentary canal or upon the surface but, if the condition is not treated surgically, death usually occurs from septicæmia, subdiaphragmatic abscess, wasting or pulmonary complications.

Operation. The abscess may bulge forwards either below or above the stomach, and therefore it may be approached through either the gastro-colic ligament or the small omentum (Fig. 270), the most direct route being selected in each case, after carefully protecting the peritoneum by gauze packing. Drainage is established by means of a large rubber tube containing a wick of rubber tissue. The wound is then partly closed.

Mayo Robson⁷ recommended a vertical posterior incision in the left costo-vertebral angle for this purpose, which is certainly more favourably placed for the purposes of drainage; great care, however, must be

¹ Mikulicz, *loc. supra cit.*

² *Ann. of Surg.*, December, 1909.

³ *Ibid.*, May, 1910.

⁴ *Journ. Amer. Med. Assoc.*, May 28, 1910.

⁵ *Ann. of Surg.*, 1912, *lv*, 23.

⁶ *Brit. Journ. Surg.*, 1924, *xi*, 476.

⁷ *Brit. Med. Journ.*, May 11, 1901.

exercised in carrying out this plan in view of the important structures which might be injured. This plan is especially suitable for large collections. After incising the muscles, dressing forceps are passed forwards into the abscess after Hilton's method.

If the surgeon has not opened the abscess in front, he can then dispense with anterior drainage and close the wound completely so as to avoid the risk of ventral hernia.

As a rule anterior drainage will be both necessary and sufficient, and there is little risk of contaminating the peritoneum if care be taken to pack around before opening the abscess.

Either immediately or later, characteristic grey or greyish black sloughs of the pancreas may come away, as in a case that I saw under the care of the late Mr L. A. Dunn. This patient, a middle aged stout woman, had suffered such agonising pain in the epigastrium and right hypochondrium that she had acquired the morphia habit. In the last attack a vague swelling appeared above the umbilicus and to the right of the middle line, vomiting became very troublesome and constipation almost complete. The abscess was opened through the right rectus muscle and gastro colic ligament. This gave immediate relief and the patient gradually made a complete recovery.

In one case Mayo Robson performed a gastro jejunostomy successfully after an abscess had burst into the stomach and continued to discharge its foul contents into the latter.

He recorded 7 operations with 5 recoveries and collected 7 others with 4 recoveries. Two of his 5 patients who recovered from the operation died later, one after a few weeks from pulmonary complications and the other from exhaustion and wasting after a few months.

CHRONIC PANCREATITIS

Riedel first pointed out the relation of this condition to cholelithiasis, but to Mayo Robson belongs the credit of defining and drawing the attention of the profession to this important subject.¹ In many cases, chronic pancreatitis is secondary to cholecystitis or to impaction of a calculus within the ampulla of Vater or in the lower part of the common bile duct or the pancreatic duct. But when an operation is undertaken the calculus may have already sloughed out or passed on into the duodenum or may not be discovered. In other cases the condition is due to an infection either ascending from the bowel or carried through the blood or lymphatic vessels. Occasionally syphilis of the pancreas causes similar symptoms.

The result is a *chronic interstitial and parenchymatous inflammation* which usually and chiefly concerns the head of the pancreas which becomes enlarged and hard so that it closely resembles malignant disease, for which it has been very frequently mistaken during exploratory operations for jaundice and other signs of obstruction of the common bile duct, under these circumstances cholecystostomy has been performed and the patient has recovered, much to the surprise of all concerned.

If left too long untreated, the patient may die of obstructive jaundice or rapid emaciation with anæmia. Long continued obstruction to the flow of pancreatic juice may result in such an amount of destruction of the

¹ *Loc. supra cit.*

pancreatic tissue as to lead to diabetes, and similarly the liver may become cirrhotic from obstruction to the biliary flow. Diarrhœa with fatty and offensive stools is common, and trypsin may be absent from the fæces.

Treatment. A thorough exploration should be undertaken and the presence or absence of any calculous obstruction of the bile or pancreatic duct ascertained, especial attention being paid to the ampullary region.

Any calculus that may be discovered is removed and this may be enough in some cases, but if there be much sclerosis of the pancreas or if no calculus be discovered, free drainage of the infective contents of the pancreatic and bile ducts must be established by performing cholecystostomy, cholecystgastrostomy or, if the cystic duct be obstructed, the common bile duct must be drained.

Cholecystostomy is easier and a little safer than cholecystgastrostomy, but a biliary fistula should be avoided if possible; cholecystenterostomy is neither so easy nor so safe as cholecystgastrostomy. When the gall-bladder is unhealthy it is better to remove it and to drain the common bile duct. The tube used for this purpose may be passed down into the duodenum to dilate the lower part of the duct, side holes being made in the tube to drain the bile.

It is almost impossible to distinguish carcinoma of the pancreas from chronic pancreatitis even when the abdomen is opened, therefore it is wise to give the patient the benefit of the doubt and to perform cholecystgastrostomy or, if he is very ill, cholecystostomy. Some fifteen years ago I performed cholecystenterostomy upon six patients suffering from chronic jaundice. Three of these were well several years after the operation. The other three died of growth within a year. My late house-surgeon, Major G. Y. Thomson, I.M.S., published an account of them with interesting comments.¹

One of these cases of chronic pancreatitis is worth quoting in full.

A man, aged 35, admitted on February 16, 1908, for pain in the upper part of the abdomen, on the right side, and jaundice. For two months he had suffered a good deal from indigestion and pain about the epigastrium and gall-bladder region, often vomited soon after meals, and occasionally had diarrhœa, and soon became jaundiced; the stools became light-coloured and the urine very dark. On admission the jaundice was a little better, but attacks of pain were very severe, being only relieved by morphia. The pain was above and a little to the right of the umbilicus, extending straight through to the back; the patient did not become pale, and there was no sickness during the attack. The upper part of the abdomen was tender and rigid, especially to the right of the mid-line; the gall-bladder was palpable. By February 19 the jaundice was worse again, attacks of pain more severe, and the patient was wasting rapidly. Exploration was advised.

Operation. The abdomen was opened through the upper part of the right rectus. The gall-bladder was found to be enlarged. No stones were felt in it or in any of the bile ducts, or at the common opening of the common bile and pancreatic ducts into the duodenum. The head of the pancreas was enlarged and hard, and was thought to be carcinomatous. A small piece which was removed only showed inflamed pancreas. No stones were felt on palpating the pancreas. Anastomosis was made between the fundus of the gall-bladder and jejunum about 9 inches from the duodeno-jejunal flexure; suturing was direct with the aid of clamps. The opening was made as large as possible, and three layers of sutures were used. The abdomen was completely closed.

¹ *Lancet*, 1911, ii, 221.

Recovery was uninterrupted, the patient never had another attack of pain, and the jaundice soon disappeared, he rapidly gained weight and left hospital on March 13, and was very soon at work again as a police sergeant. He remained quite well for nearly four years and then developed a moderate degree of jaundice, which persisted in spite of medical treatment. He wasted a little, and complained of itching and indigestion. His abdomen was opened again, and the pancreas was found to be very small and very hard, with complete obstruction of the common duct. The anastomosis was thought to be contracted, and was enlarged without any effect. It is probable that the jaundice, which was slight and variable was due to an ascending cholangitis without fever. Gradually it cleared up, and when last seen the patient was quite well—twelve years after the operation.

In Mayo Robson and Cammidge's work thirty nine cases of chronic pancreatitis treated by operation, with only two deaths, are quoted, and the after histories of these patients are good.

PANCREATIC CALCULI

The late Sir Alfred Pearce Gould removed a pancreatic calculus in March, 1896, but the patient died twelve days later. Sir Berkeley Moynihan was the first to correctly diagnose and successfully remove a stone from the duct of Wirsung in May, 1902.¹

The patient 'was a lady, aged 57, who had suffered for several months from symptoms which may be briefly described as follows. There was steady loss of health, gradual wasting, irregular pigmentation of the skin in patches of the colour of café-au lait (very closely resembling the pigmentation of molluscum fibrosum), persisting attacks of epigastric pain and uneasiness of the type of hepatic colic, though less severe and unattended, until very late in the history, by jaundice, which was then always trivial, though unmistakable, and pain passing through from the front of the abdomen to the middle of the back. There was no rigor or any complaint of sensation of heat or cold. The stools were occasionally frothy and greasy. On examination under chloroform some indefinite swelling could be felt above the umbilicus and a little to both sides of the median line, though chiefly to the right.'

Moynihan diagnosed chronic pancreatitis, due probably to a pancreatic calculus, which had produced the epigastric colic during its transit along the duct of Wirsung and had later caused some inflammatory obstruction of the common bile duct. The abdomen was opened by separating the fibres of the right rectus muscle, and the diagnosis was confirmed. 'The head of the pancreas was very much enlarged and hard, the body was less so, but still larger and denser than the normal.' A small lump was felt between the duodenum and the pancreas, and upon opening the duodenum and the ampulla of Vater a small soft stone was discovered at the end of the duct of Wirsung, whence it was removed with a scoop. The patient made a complete recovery and was quite well in March, 1905.

Mayo Robson, Dalziel, and L. W. Allen have also removed stones from the pancreas.

Mayo Robson² successfully removed four pancreatic stones, two from the ampulla after opening the duodenum and one each from the ducts of Santorini and Wirsung. The ducts and the pancreas were sutured, and no drainage was employed.

There were only four operations for pancreatic stones at the Mayo Clinic³ during the eleven years 1910-1921, all the patients recovered.

Pancreo Lithotomy. Pancreatic calculi may be removed (a) from

¹ *Lancet*, 1902, ii, 355.

² *Lancet*, 1904, ii, 113.

³ W. E. Baurhup, *Collected Papers of the Mayo Clinic*, 1921, xiii, 1016.

the duodenum, and through the ampulla of Vater by a slight modification of the operation of duodeno-choledochotomy (*see* p. 474).

(b) If this is impracticable, the pancreas may be approached through the gastro-hepatic or gastro-colic omentum, and an incision made directly over the stone and parallel to the duct. When the stone has been removed both the duct and the pancreas should be carefully sutured, but drainage should be established from the line of suture to avoid any possible leakage and peritoneal contamination. A sandbag under the

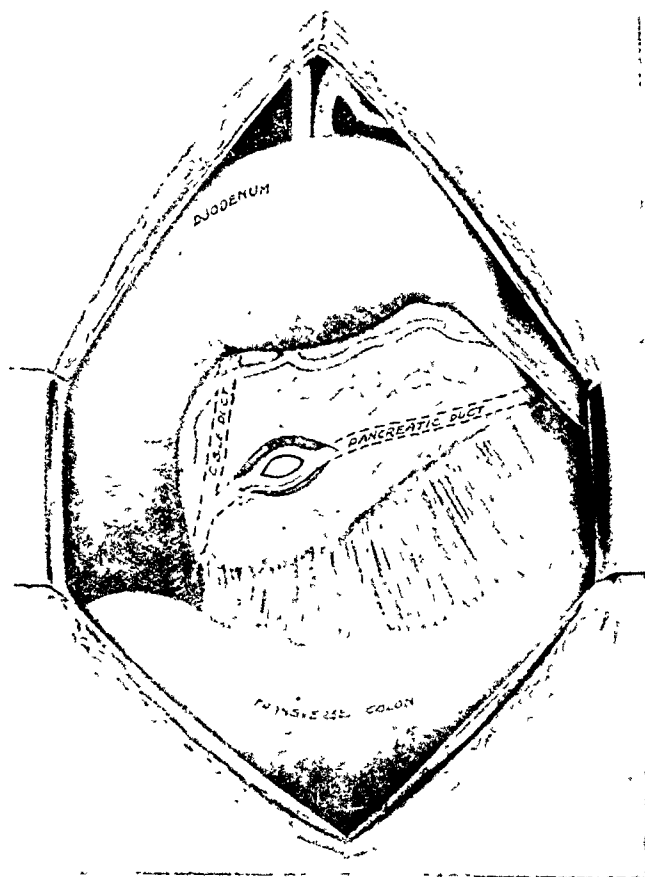


FIG. 271.

back is of great value in bringing the duodenum and the pancreas much nearer the surface.

Link¹ records the remarkable case of a young woman from whose pancreatic duct he removed many small calculi and then drained the duct through the pancreas tail, which he brought forwards into the abdominal wound, after sewing the pancreatic tissue over a rubber tube leading from the duct. The patient did very well and gained twenty pounds in three months. R. C. Coffey² advocated pancreato-enterostomy in similar cases.

¹ *Ann. of Surg.*, 1911, liii, 768.

² *Trans. South. Surg. and Gyn. Assoc.*, 1909, xii, 126-160.

PANCREATIC CYSTS AND PSEUDO-CYSTS

Moynihan¹ gives the following classification of these cysts

- (1) Retention cysts
- (2) Proliferation cysts { Cystic adenoma
 { Cystic carcinoma
- (3) Congenital cystic disease
- (4) Dermoid cysts
- (5) Hydatid cysts
- (6) Hæmorrhagic cysts
- (7) Pseudo-cysts

Effusions into the lesser sac of the peritoneum were for long mistaken for pancreatic cysts, partly because the fluid withdrawn from these pseudo cysts often contained pancreatic secretion, and partly because the pancreas formed a part of the wall of the cyst

Jordan Lloyd first drew attention to the true nature of the so called cysts which followed injuries of the upper part of the abdomen². They generally take the characteristic shape of the lesser peritoneal cavity and if the pancreas has been injured their fluid contents may have 'the property of converting starch into sugar

McPhedran³ recorded an interesting example of this condition and later a true pancreatic cyst developed in this patient probably due to obstruction of the pancreatic duct

The late T H Kellock⁴ described another instance of 'traumatic pancreatic pseudo cyst' and refers to seven more. In four out of these eight cases the injury was a kick from a horse

Diagnosis of Pancreatic Cysts Attention to the following points will generally lead to a correct conclusion. A rounded elastic deeply fixed swelling, which may date to an accident appears usually in an adult in the epigastric and left hypochondriac regions and is generally accompanied (especially when its increase is rapid) by coeliac neuralgia — i.e., pains probably arising in the solar plexus—often colicky or even agonising and leading to collapse. Dyspepsia wasting marasmus and mental depression are often present to a marked degree. The position of the cyst, behind the stomach and transverse colon, is important. This relationship may be demonstrated by percussion with or without inflation of the stomach and colon with gas, and also with the aid of an opaque meal or of a rubber tube containing an emulsion of bismuth and the shadow thrown by this upon the X ray screen (Dalton). Both side to side and front to back shadows should be taken. Buckstein⁵ has used a similar tube to demonstrate an increase in the size of the duodenal curve.

The resonance of the stomach is often above the cyst and that of the colon below it, the centre or most prominent part being dull.

The cyst may present and be dull above the stomach or below the transverse colon towards the left loin. I have known such a cyst mistaken for hydronephrosis. The cystoscope, with the aid of indigo carmine injected into a vein or the help of the ureteral catheter, will distinguish the two conditions, for equal amounts of urine should issue from the two

¹ *Abdominal Operations* 4th Ed. II, 480

² *Brit Med Journ*, 1897, II, 1085

³ *Brit Med Journ*, 1897, I, 1400

⁴ *Clin Soc Trans*, 1908, XXXIX, 63

⁵ *Surg Gyn. and Obstet*, 1924, XXXIX, 209

ureters if the cyst is pancreatic, whereas the amount and the characters of the separated urines will be different in hydronephrosis, even if any comes from the left ureter. The urine may contain sugar, and diabetes is not uncommon; it was present either before or after operation in three out of the forty-one cases recorded at the Mayo Clinic.¹ The fæces may contain an excess of fat or muscle fibre in a few cases; and, rarely, jaundice is observed when the cyst occupies the head of the pancreas and obstructs the common bile duct. Bronzing of the skin has been noted in a few cases.

The distinction between true and false cysts is made chiefly by the definite history of injury, which practically always causes a false cyst, but as a rule the diagnosis cannot be certainly established before operation and microscopical examination of a piece of the wall of the cyst. If the latter is lined by columnar epithelium the cyst is truly pancreatic, either adenomatous or carcinomatous according to the absence or presence of infiltration of the stroma.

Treatment. Dr. Senn showed that the wisest course was incision of the cyst by abdominal section. The results of attempting to extirpate the cyst have been so unsuccessful as entirely to justify his condemnation of this course except in quite exceptional cases. Aspiration is not to be recommended because it is never successful and is not without danger. It is not even advisable to employ it for diagnostic purposes (*see* footnote 3 below) or for the temporary relief of tension.

(1) **Evacuation and drainage.** The cyst is approached as already described at p. 496. Generally it is best to incise the gastro-colic ligament, great care being taken to avoid wounding the stomach or colon, which may lie collapsed and perhaps adherent in front of the cyst and difficult to recognise owing to inflammatory changes.

The following case,² on which the late Mr. Jacobson (whose account is given) operated at the request of Dr. Newton Pitt, is a good instance of a pancreatic cyst treated by laparotomy, incision and drainage:

I received the following history when asked to see the case, August 21, 1889. The patient was 21. He had received a kick in the abdomen three years before which had confined him to bed for three weeks. Ever since he had been liable to severe attacks of epigastric pain. He had been markedly jaundiced, was emaciated and suffered a good deal from nausea and depression. The swelling in the epigastric region was convex and uniform and reached from below the tip of the ensiform cartilage to just above the umbilicus, and laterally to near the ends of the eleventh ribs. The tumour gave the impression of being attached to some deep-seated structure. There was transmitted impulse synchronous with the pulse, but not expansile. As the swelling had refilled after two previous tapplings,³ and as the

¹ E. S. Judd, *Collected Papers of the Mayo Clinic*, 1920, xii, 406.

² *Trans. Med.-Chir. Soc.*, lxxiv, 455. References are given to 30 cases which will be found summarised there by Dr. Pitt. References are also made to 13 cases by Mr. Cathcart in his instructive paper (*Edin. Med. Journ.*, July, 1890).

³ The fluid was alkaline, sage-green, sp. gr. 1013, albuminous and, under the microscope, showing innumerable collections of globular masses of tyrosin crystals. No leucin could be detected. The fluid in these cysts varies a good deal—sometimes colourless and serous; at others it is red and viscid. It will be seen from the account that follows that on each occasion the aspirating needle must have transfixed the stomach. The same thing, with like harmlessness, happened in one of Kurewsky's two cases (*Deut. Med. Woch.*, No. 46, 1890). In two cases the preliminary puncture was followed by evidence of peritonitis, and in two by grave collapse attending the escape of fluid from the cyst into the peritoneal sac. Another possible danger is puncture of the transverse colon, which may be tightly stretched over the cyst. If fluctuation can be detected in the infra-costal region behind or if a thrill can be obtained here from the front, it will be safer to aspirate from behind.

swelling, and the patient's distress were steadily increasing laparotomy was performed August 22 with strict antiseptic precautions. An incision, three inches long, was made over the most prominent part of the cyst an inch and a half to the left of the middle line extending to within an inch of the umbilicus. The parietal peritoneum having been stitched to the margins of the wound the lower edge of the liver could be seen moving with respiration in the upper angle while the rest of the incision was occupied by a smooth reddish surface which bulged strongly forwards. Taking this to be the front of the cyst and having ascertained before the operation that the cyst was dull on percussion I was about to leave this for twenty-four hours to become adherent before it was incised. The result proved that if I had done so the scalpel would have passed through both walls of the stomach. Before dressing the wound I again scrutinised the surface of the supposed cyst and thought I found evidence of involuntary muscular fibre which threw doubts upon the swelling being a pancreatic cyst. When the supposed cyst was examined between the fingers it proved to be the empty stomach stretched very tightly over the subjacent cyst. To get at this the stomach was drawn upwards that it might be packed away above under the liver. But here an embarrassing difficulty arose. As I pulled up the stomach which was tightly jammed between the bulging cyst behind and the parietes in front the omentum came up into the wound in front of the cyst. The tension of the parts was so great owing to the rapid increase in the cyst that there was no room above in which to pack away the omentum. Pushing this to either side already fully occupied pulled down the stomach again. I accordingly drew the greater part of the omentum out of the wound.¹ Some of it was tied with catgut and cut away much of it was left heaped up on the abdominal walls of either side of the incision. One or two fine catgut sutures retained the omentum in position. I next scratched through the two layers of omentum and exposed the surface of the cyst for a space the size of a shilling. There was thus a somewhat conical passage leading from the abdominal incision through a mass of omentum down to the anterior surface of the cyst. This last was very vascular and so tense that it was not thought advisable to put in a guide suture. The patient passed through the next twenty-four hours fairly well. At midnight August 23 symptoms of collapse set in (hæmorrhage probably took place at this time into the cyst a complication which must always be probable owing to the very vascular surroundings). The patient's pulse at 2 A.M. had run up to 163 and his condition pointed to a fatal ending at no distant date. At 3 A.M. I passed a fine trocar into the cyst and drew off 12 oz. of deeply blood stained fluid which was under very high tension. The sac was then incised and a large drainage tube inserted. A marked improvement at once set in. A slight discharge of dark treacly fluid necessitated changing the dressing twice a day at first. The wound was all healed in two months (*vide infra*).

On another occasion I should prefer to pack around and empty the cyst at once either by aspiration or by a large trocar and tubing or by a small incision keeping the cyst well forwards by means of forceps attached to the cut edges. Then as the cyst emptied a finger as a guide having been introduced into the cyst and pushed downwards and outwards below the left infra costal margin a counter opening might be made and a large drainage tube inserted into the cyst from behind. This would be shortened from time to time as gradual contraction of the cyst took place. The anterior opening in the cyst could be either sutured or attached to the margins of the abdominal incision. Mr Cathcart left the opening in the front of the cyst open. Sir A. P. Gould closed his by suture.

Mr Caird² acting on Mr Cathcart's plan of making a counter opening behind opened one of these cysts at the back and not through the anterior abdominal wall as is usually done. The incision was made along the outer border of the erector spinæ just below the twelfth rib and a tube inserted. This was kept in for four months and later on iodine was

¹ On another occasion I should divide the omentum above the transverse colon.
² *Edin Med Journ* February, 1896

injected occasionally to promote obliteration of the cyst. The patient was ultimately discharged, with the opening closed. The administration of liquor pancreaticus with the food was thought to have been beneficial. All will agree with what Mr. Cathcart claims for the posterior incision, viz. (1) that the cyst can here be reached extra-peritoneally; (2) that this incision gives better drainage; and (3) that by it there is less risk of a ventral hernia. But the anterior incision is far better for exploratory purposes and, moreover, anterior drainage has been found to suffice in most cases. I have seen one pseudo-cyst drained successfully through the anterior part of an incision made for the exploration of a supposed hydronephrosis.

The after-history of any case of pancreatic cyst reported as cured by drainage must be carefully watched. It is clear that under certain conditions—*e.g.*, where the cyst is very large, where it has thick walls, and above all where the duct communicates with the cyst and where much of the tissue of the pancreas remains—**recurrence** is almost certain and complete obliteration by drainage probably impossible. As in most of these cases the intimate relation of these cysts with very vital parts does not admit of their being dissected out, we must be prepared to fail sometimes in our efforts to secure a radical cure. This is shown by the sequel to Dr. Newton Pitt's and my case, which was brought, as one treated successfully by drainage, before the Medico-Chirurgical Society (*vide supra*). About a year later I heard that the swelling had reappeared and that the man was about to be operated on again. Later on I was given to understand that the swelling had reappeared a second time, but I have been unable to obtain the needful information. Dr. M. H. Richardson, of Boston, drew attention to this tendency of pancreatic cysts to recur after drainage and described an interesting case.¹ At the necropsy it was found that the head of the pancreas was normal, and that a tube could be passed from the pancreatic duct into the cyst; about two inches of normal pancreatic tissue was found lying between the cyst and the spleen. From this also a duct could be traced into the cyst. It was very difficult and even impossible at the time of the necropsy to dissect out the cyst from the parts to which it was adherent. Dr. Richardson thinks that in some cases the permanent use of a tube will be needful. Sir A. P. Gould published² a case of pancreatic cyst which had been treated by drainage; a sinus persisted in spite of treatment and, three years later, became the site of epitheliomatous infiltration. Dr. O. Ramsey, of Baltimore, in a case of a large pancreatic cyst treated by drainage, was obliged to continue the use of a drainage-tube seven months after the operation, as the discharge was still free.³ Some of these recurrences may have been due to the adenomatous or primarily malignant nature of the cyst, and for this reason it is always advisable to remove some of the wall of the cyst for microscopical examination. Radium⁴ has been introduced into the cyst to hasten recovery and, with the same object, some of the epithelial lining of the cyst has been stripped off by gauze dissection and removed.

Extirpation. On account of the slow recovery and occasional recurrence after evacuation and drainage, extirpation has been practised and

¹ *Boston Med. and Surg. Journ.*, 1892, cxxvi, 441.

² *Lancet*, 1891, ii, 290.

³ *Ann. of Surg.*, December, 1895.

⁴ C. S. Hamilton, *Surg., Gynec. and Obst.*, 1922, xxxv, 655.

recommended, but it is not often either advisable or practicable on account of the extensive adhesion to vital parts and the large blood-vessels in and around the cyst

Even Mikulicz had to abandon two attempts and the splenic vessels had to be tied in two instances (Mikulicz and Billroth) When the cyst is peduncled or chiefly concerns the tail, it may be safely and very properly excised, the pedicle being ligatured sutured or clamped Drainage only was adopted in 31 of the cases at the Mayo Clinic excision in five and enucleation of the lining membrane in three The results were good, for there were no deaths from the operation itself, although there were several from complications later on

Mayo Robson¹ collected the records of 160 operations for pancreatic cysts, 140 of the patients recovered from the operation or were presumed from the records to have recovered Four of the cases were doubtful in this respect Out of 138 patients treated by incision and drainage 16 died—a death rate of 11.6 per cent Out of 13 complete excisions three died (20 per cent) Out of seven partial excisions one died (14.3 per cent)

It must be remembered, however that only the most movable and comparatively small cysts were excised so that the figures do not represent the comparative danger of drainage and extirpation the latter of which is only suitable for occasional cases It is interesting to notice that eight of the patients died of peritonitis two from shock one from collapse one from intestinal obstruction and one from gangrene of the pancreas Out of the patients who survived the operation one died later of diabetes, one from tuberculosis and one from hæmorrhage after a year and a half Mr Sampson Handley² successfully excised the body of the pancreas for chronic cystic pancreatitis with calcareous degeneration, and he gives the following account —

"Mrs S, aged 60, was seen with a mobile lump above and slightly to the right of the umbilicus She suffered much from epigastric pain and tenderness accompanied by nausea, and not definitely relating to food

March 1923 Explored abdomen The head of the pancreas was normal the body presented a hard granular thickening infiltrated by calcareous deposit which was diffused throughout the substance of the gland Numerous cysts were also present The head was therefore clamped off and body stripped off from the splenic vein In the region of the tail there was much oozing so the tail also was clamped and left behind In this region it was necessary to pack with vaseline gauze to check the oozing Temporary drainage On tenth day some sloughs escaped from the sinus, probably indicating a pancreatitis of the remaining portion of the tail Several pieces of calcareous deposits also came away This time there was some pyrexia Epigastric pain entirely disappeared The sinus closed in about two months The patient has since remained in satisfactory health The sinus closed about July, 1923, but reopened with the escape of further pus When I saw the patient in December, 1923, the wound had quite healed There was no sugar in the urine She had not gained weight, nor lost it Her pain had disappeared"

False pancreatic cysts should be drained either anteriorly through the gastro colic or gastro hepatic omentum or posteriorly below the last rib in the left loin, the first alternative is generally the best The following cases are good examples of this condition —

CASE 1 *False Pancreatic Cyst*—A boy, aged 9 years, was injured eight weeks before admission by a bicycle, the carrier of which hit him in the front of the abdomen

¹ *Loc. supra cit.*

² *Proc R. S. M., 1923-24, xvii, Surg. Sect., p. 89*

He was taken in an unconscious condition to a hospital, but was discharged two days later, nothing abnormal being noticed in the abdomen. Nevertheless, he wasted very much and had several attacks of vomiting and looseness of the bowels. He was admitted to Guy's Hospital on September 19, 1923, and a swelling was then noticed for the first time in his epigastrium. It was the size of a coconut and occupied the greater part of the epigastric, umbilical and left hypochondriac regions, extending downwards below the umbilicus. The upper and greater part of it was dull, the dulness being continuous with the liver dulness. The lower part gave stomach resonance and splash. It moved freely with respiration and could be felt from behind and, bimanually, through the left loin, but there was resonance in the outer part of this space, behind and in front. The lower edge of the liver was very prominent in the epigastrium. The temperature and pulse were normal. The X-rays did not help much, but showed that the stomach was pushed to the left and that the diaphragm was not elevated. There was some diffuse opacity in the situation of the swelling. Diagnosis: Traumatic effusion into the lesser sac. An incision was at once made in the left epigastrium and the diagnosis confirmed. The lesser omentum bulged and was bluish in colour. It was incised and a large quantity of slightly blood-stained fluid evacuated; this was examined by Dr. J. H. Ryffel and found to contain pancreatic ferments. The pancreas was felt behind the cyst, and seemed to be normal. A drainage tube, $\frac{1}{2}$ inch in diameter, was secured in the cavity in an airtight manner and left in for three days. The patient went to a convalescent home a fortnight after the operation. There was still a very slight discharge of clear non-irritating liquid from the wound. The boy made a complete recovery.

CASE 2. *False Pancreatic Cyst containing Bile.* In 1912, a lady, aged 42, was seen by one of us with the late Dr. Brookhouse, of Bromley. In 1905 another surgeon had removed her gall-bladder, containing forty stones, but she continued to have frequent attacks of colic, never lasting more than twenty minutes and never causing jaundice. At last she consented to another operation, which proved to be very difficult owing to extensive adhesions and hemorrhage. Three gall-stones were found and removed from the common bile duct, and a tube was passed down towards the incision in this duct, but not into it. This was clearly a mistake and led to the subsequent trouble. After the operation the patient had a bad night and looked ill the next morning. The temperature was 100.8° , pulse 140 and respiration 40; the pulse remained quick for some days. Two days later she was faint and had an intermittent pulse of 150 (temperature 101° , respiration 36), and looked very ill. She was thought to be suffering from cardiac failure, and injections of digitalin and strychnine were given. The abdomen was supple, only slightly distended, a little tender and full in the left hypochondrium. The next morning, when Dr. Brookhouse removed the tube, a large amount of bile escaped and continued to do so during the day, clearly showing that the tube had not been draining the common bile duct satisfactorily. The patient was better for several days—the pulse coming down to 90—but five days later the symptoms returned. There were diarrhoea and fainting attacks, with an intermittent pulse. There was also pain in the left flank, which was distended and rigid, and a large rounded swelling was felt, and thought to be a collection of fluid, in the lesser sac of the peritoneum. Another operation was carried out on the thirteenth day, and a very large quantity of altered bile was drained forwards from the lesser sac through the gastro-colic omentum. The patient made a rapid recovery. It was thought that the collapse, supposed to have been due to cardiac failure, was really caused by over-distention of the lesser sac of the peritoneum, with irritation of the celiac plexus.

GROWTHS OF THE PANCREAS

Very few operations have been undertaken for new growths of the pancreas. The most common malignant neoplasm is carcinoma, especially of the head of the gland; but occasionally fibro-sarcoma occurs.

Mayo Robson¹ collected records of sixteen operations for the removal of solid tumours of the pancreas, with eight recoveries from the operation, but the prolongation of life was of short duration.

¹ *Hunterian Lectures, loc. cit.*

J. D. Malcolm removed an enormous fibro sarcoma of the pancreas from a child, but the patient died of shock soon after the operation, and the portal vein was found at the autopsy to be full of growth¹. Sherrin records a successful resection of an encapsuled movable sarcoma of the pancreas². Kinney records a resection for cystadenoma³.

Mayo Robson records the results of twenty eight palliative operations for malignant disease of the head of the pancreas. These were undertaken chiefly with a view to making a diagnosis between chronic pancreatitis and carcinoma. Of fifteen cholecystostomies eight recovered but the longest survival was eight months the average being only four months. Out of six cholecystenterostomies only two recovered and they only survived for a few weeks.

The mortality of the operation has been much reduced by improvements in technique. It is certainly worth doing the operation early in doubtful cases for even upon exploration it is often impossible to distinguish chronic pancreatitis from carcinoma. Surely it is worth while giving the patient the benefit of the doubt for cholecystgastrostomy will almost certainly save his life if the disease is inflammatory and in any case he will be relieved of his intolerable itching and jaundice and his life will be somewhat prolonged. The value of the bile and perhaps some pancreatic juice for digestive and aperient purposes are to be considered in comparing cholecystgastrostomy and cholecystostomy and a greater risk is worth running in order to avoid a biliary fistula.

It may be possible to remove a growth of the tail or body of the pancreas if discovered early. The important relations of the head of the pancreas to the duodenum common bile and hepatic ducts and especially to the portal and superior mesenteric veins make it impossible to remove malignant growths of this part. Malignant cysts may be occasionally drained with temporary relief. Growths of other organs such as the stomach or the colon which trespass upon the pancreas are nearly always best left alone and if the pancreas is either accidentally wounded or a part of it purposely resected it is essential to drain the wound to prevent contamination of the peritoneum with the secretion that oozes from wounds of the pancreas.

¹ *Trans Path Soc* 1902 li 420

² *Lancet* June 3 1911

³ *Ann of Surg* June 1913

CHAPTER XXIII

OPERATIONS ON THE KIDNEY AND URETER

BEFORE undertaking an operation upon any of the urinary organs the surgeon should, of course, ascertain the state of the general health of the patient, and he should also endeavour to gain all the information he can about the condition and functional capacity of each one of the urinary organs. He should make every effort to distinguish urinary diseases from those that simulate them, and to determine the exact site, extent and nature of the disease of the urinary organs. It is especially important before operating upon one kidney to know the state and working capacity of the other. By means of more comprehensive examinations the surgeon may hope to make more accurate diagnoses, and to avoid useless or incomplete operations. Armed with a full knowledge of the value of the other kidney, the surgeon can more easily decide upon the extent of the operative treatment permissible in a given case, as well as the nature of the prognosis that may be given. On the other hand, valuable time must not be wasted on useless investigations, and vexatious or dangerous ones must not be undertaken unless they are likely to lead to useful conclusions. In addition to the valuable information to be obtained from the history, symptoms, physical signs, chemical, microscopical and bacteriological examinations of the urine, the catheter and the sound, there are other means which may provide more accurate knowledge in some cases. *Cystoscopy, ureteral catheterisation, skiagraphy including pyelography, the estimation of the urea in the separated urines and in the blood, and the power of the kidney to excrete urea, indigo carmine or other substances injected into the veins*, may complete the diagnosis made by the older methods.

The surgeon must decide which of these additional methods of investigation to use and rely upon in any given case.

NEPHROSTOMY

Indications. The following are the principal conditions which demand this operation :

(i) **Pyonephrosis and Abscess of the Kidneys, Acute ascending Pyelonephritis.** (a) When the abscess is due to calculi, these will be removed and the cavity drained, except in special cases where nephrectomy is indicated (*vide infra*, p. 530). Temporary drainage of an infected kidney reduces fever and restores the renal function when a patient is too ill for any attempt at radical treatment. (b) When the abscess is due to unilateral tuberculous disease, it is rarely wise to perform preliminary nephrostomy, for it is usually safer and easier to remove the kidney at once, but occasionally when the kidney is very large and distended with pus, in the presence of fever from mixed infection, or when there is evidence of disease of the opposite kidney or of other viscera, nephrostomy

is a temporary or permanent expedient. The results, however, when a secondary nephrectomy cannot be performed are as might be expected, extremely unsatisfactory. Otto Ramsay of Baltimore,¹ gives the results of fifty-five cases. Of these, four at the most, and probably two only, can be considered as cured. (c) In a few instances pyonephrosis may be due to a stricture or kinking of the ureter. An example of this condition is referred to below under the Surgery of the Ureter (see p. 577).

(ii) **Hydronephrosis.** If the kidney has not been hopelessly destroyed or the size of the tumour prevents removal, incision and drainage should be employed either as a method of cure or as a preliminary to a secondary nephrectomy. When the other kidney is known to be good, primary nephrectomy is better, but in many cases a plastic operation to remove the obstruction of the ureter is practicable and hopeful.

(iii) As an *exploratory operation* for diagnostic purposes for certain obscure renal symptoms. Some of the conditions that have been found are mentioned below under Nephro-lithotomy (see p. 519), in others a calculus will be found. In others again particularly where the only symptom is hæmaturia, the exploration may have a negative result.

(iv) **Anuria.** This will be dealt with later (see p. 532).

Operation. As this is identical with the first stages of a nephro-lithotomy the reader is referred to the description of that operation (p. 521). The kidney is incised a little behind its convex border while the vessels of the pedicle are controlled by the fingers or suitable clamp. The length of the incision varies with the need. The pelvis and calyces are examined with the finger and inspected if necessary. The renal incision is closed (usually round a drainage tube) with stout catgut sutures, introduced with a curved round needle, and tied gently but firmly to prevent or arrest bleeding. Mattress sutures are sometimes required (Fig. 375).

NEPHRO-LITHOTOMY AND PYELO-LITHOTOMY

The following are the chief symptoms and conditions justifying exploration of the kidney for stone:

(1) *Continued Hæmaturia* ² *without evidence of Nephritis*

A few words as to the character of the hæmaturia of renal calculus and the fallacies which must be borne in mind. It is a hæmaturia of long standing, often repeated, frequently increased by exercise or jolting, rarely profuse and never producing anaemia, as in growth of the kidney. Always intimately mixed with urine, the tint varies from a bright or deep red (which I think is rare) to a smoky or porter like colour.

Fallacies. (a) Hæmaturia may be absent from first to last. This, an undoubted fact, is one very difficult of explanation. (b) It may be only temporary, this occurs, though rarely, when a small renal calculus becomes encysted.

The value of hæmaturia, though only occasional, is shown by a case of Dr. Owen Rees, to which the late Sir Henry Morris drew attention.

It was that of a young lady with lumbar pains and frequent micturition which were both put down to the hysteria that was markedly present. After a while hæmaturia was found to be present on several occasions, and eventually after death, a mulberry calculus was found in one kidney.

¹ *Ann. of Surg.*, 1900, xxxi, 461 *et seq.*

² Being convinced of the frequency of errors of diagnosis in renal calculus, Mr. Jacobson has dealt with these fully (*Bru. Med. Journ.*, 1890, i, 117).

Other fallacies are presented by the host of kidney conditions which may give rise to hæmaturia—namely, (1) the passage of uric acid crystals ; (2) tubercular kidney ; (3) granular kidney ; (4) growths. To these I shall refer later.

(2) *Pain and Tenderness, Lumbar and elsewhere.* (a) **FIXED LUMBAR PAIN.** Character : Generally dull, gnawing, pricking, or aching, increased usually by exercise, twisting from side to side, or flexing the body.¹ (b) **RADIATING PAIN**, for example, in the testis,² region of the small sciatic nerve, calf, foot or in the intestine simulating colic. It is easy to see how readily the pain of a renal calculus, if limited to distant parts and if occurring without hæmaturia, may mislead. Another point with regard to the pain of renal calculus is the frequency of nocturnal exacerbations. The explanation of this is doubtful ; Sir Henry Morris suggested the passage of flatus in the colon at this time over a stone in the renal pelvis.

(c) **RENAL COLIC.** Very acute in character, radiating from the loin, usually downwards, and accompanied often by rigors, nausea, vomiting, profuse perspiration and retraction of the testicle. The attacks are usually recurrent, and vary greatly in severity. The colic may be due to a stone either passing down the ureter or gripped in the lower part of the renal pelvis and obstructing the flow of urine ; here a stone frequently acts as a ball-valve.

Tenderness. Mr. Jordan Lloyd,³ in a paper to which I shall have again to refer, wrote thus : “ I attach great importance to the evidence to be obtained by immediate percussion over the suspected organ, a method of investigation which has not received that amount of attention to which it is entitled. It is best practised from the loin, just beneath the space between the tips of the last two ribs, and should be made in a direction upwards, forwards and slightly inwards. It is best for the patient to stand upright before you. The blow should be sharp and decisive, and of force sufficient to affect a structure situated several inches below the surface. It may also be practised from the front, at a point midway between the umbilicus and ninth rib. When a calculus is present, the patient will complain of sharp, stabbing pain at the moment of percussion. Other conditions doubtless give rise to percussion pain, but not of the characteristic stabbing of calculus.”

I have tried the percussion test in many cases and have found it useful, but far from infallible.

(3) *Points in the Previous History.* Space will only allow of my noticing a few of those given above, namely, lithiasis and oxaluria, history of previous passage of a stone, history of previous colic.

The history of long-standing lithiasis and oxaluria is of obvious importance, from the fact that the habitual passage of crystals or gravel and the formation of a calculus lie not far apart.

¹ As in going upstairs ; probably from the pressure on the kidney by the contracting psoas. But the relation of the pain to movement, and the kind of movement which most induces pain, vary greatly. Thus Mr. Butlin's patient is said to have suffered greatest pain when driving, least when riding. Prolonged walking seems the most frequent cause.

² In a case of Mr. Butlin's (*Clin. Soc. Trans.*, xv, 113) the patient sought relief from severe neuralgia of the right testis, which was generally retracted and extremely tender. Later on it was noticed that these neuralgic attacks were associated with some lumbar pain and tenderness. Complete recovery followed the removal of a small, prickly, calcium-oxalate calculus from the pelvis of the right kidney.

³ *Pract.*, xxxix, 178.

(4) *Frequency of Micturition* The co existence of irritability of the bladder with renal calculus is well known, and may be explained either by nerve disturbance, by the blood and pus or by the over acid urine which often accompanies stone in the kidney

(5) *Pyuria*, especially when unilateral in origin Occasionally pyuria is the only sign or symptom of stone until a shadow is discovered during the routine X ray examination

(6) The X rays afford the most reliable evidence of the presence or absence of a stone in the kidney, but even in the hands of experts they are not always conclusive A small urate stone in the ureter or pelvis of a stout patient is often overlooked

(7) Cystoscopic examination after the intravenous injection of indigo-carmin is especially valuable when the X rays have failed Under these circumstances the cystoscope has frequently enabled me to diagnose obstruction of one ureter, and the subsequent operation has revealed a small stone in the ureter or pelvis

(8) *Failure of Previous Treatment to give Relief* Sir Henry Morris¹ pointed out that any prolonged course of palliative treatment is to be deprecated, for during this time the stone may be steadily but slowly destroying the kidney

(9) *Calculus Anuria* Exploration of the kidney in this extreme condition is urgently required (see p 532)

Conditions which may simulate Renal Calculus. Before deciding to operate on a given case, it must be borne in mind, in addition to what has been already said that other diseases may mimic renal calculus

So closely do some of these conditions simulate renal calculus that a correct diagnosis can only be arrived at by means of an exploratory operation, but this is rare with our improved methods of diagnosis Morris² gives a list of no less than forty four cases occurring in his own practice in which the kidney was explored for stone, and no stone found In a few of the cases a calculus was passed soon afterwards, so may have been lodged in the ureter at the time of the operation In the majority, however, some other morbid condition of the kidney or ureter was found and remedied He said "It is certain that the diagnosis of calculus, though incorrect, was advantageous to the patients, for the very reason that it led to the exploration, and in this way to the discovery of the true cause of the disease"

These conditions simulating calculus must now be severally considered They may be usefully divided into two groups—affections of the kidney and ureter, and diseases of other organs

A Affections of the kidney and ureter which simulate renal calculus

(1) *Lithiasis* I have already alluded to this condition as one which simulates renal calculus by the hæmaturia which crystals of uric acid may cause Lumbar and testicular pains are also points which mere lithiasis shares with renal calculus The diagnosis will not be difficult by watching the result of treatment, which only gives relief in the one, but clears up the other Exercise, again, is a test

(2) *Tubercular Kidney* Lumbar pain and tenderness, frequent mic-

¹ *Hunterian Lectures* 1893

² *Loc supra cit*

turition, and hæmaturia are all common to tubercular kidney and renal calculus. The chief aids in the differential diagnosis are :

(a) *Skiagraphy*. Even now the X-rays may fail to discover a small stone impacted in the ureter. It is often wise to repeat the examination. On the other hand the X-rays may give definite evidence of enlargement of a tuberculous kidney.

(b) *The careful examination of the urine*. With tubercular kidney, the sediment contains caseous matter and the specific bacillus. While I am well aware of the occasional want of success in demonstrating the presence of the bacillus in urine as in bone, yet repeated examinations by an expert rarely fail to demonstrate it. Inoculation experiments are more decisive but take several weeks.

(c) *Cystoscopy*. This is very valuable and nearly always reveals tuberculous disease of the bladder, especially around one of the ureteral orifices, which may be inflamed, œdematous or retracted. After the intravenous injection of indigo-carmin little or no pigment may be seen to issue from the diseased kidney, and separation of the excretions of the two kidneys by ureteral catheterisation serves to show whether the disease involves one or both kidneys.

(d) *Early pyrexia*. I do not here speak of the fever which accompanies the advanced stage, but of the pyrexia which may be an important factor in the diagnosis much earlier in the case. Often intermittent at first, and liable to be overlooked in the anorexia, nausea and debility which accompany it, later on, and too late, it becomes only too evident and confirmed.

(e) *The failure of the general health and the evidence of tubercle in the lung, testes or vesiculæ*. The discovery of tuberculous disease elsewhere is very important. Mr. Lucas has pointed out that the corresponding ureter may sometimes be felt to be enlarged and tender by vaginal examination.

(3) *Hydronephrosis* due to stricture of the ureter, pressure of abnormal renal vessels or a valvular obstruction at the commencement of the ureter. Many remarkable cases of this nature have been described, notably those of Morris and Fenger. These will be referred to later, pp. 577 to 587.

(4) *Slight Pyelitis, not Tubercular*. This condition may, by hæmaturia, pus in the urine, lumbar and testicular pain, simulate renal calculus closely. It is frequently due to bacillus coli infection, and often occurs in women during or after pregnancy. It may follow gonorrhœa or stricture of the urethra.

(5) *Movable Kidney*, especially if associated with neuralgia, pyelitis, or if recurring with some of the reflex causes of nephralgia to be mentioned below.

(6) *Aching Kidney*. Under this title Dr. M. Duncan has described a condition, especially common in women, which may simulate renal calculus. Its chief features are a heavy, wearying pain, deep in the side, usually accompanied by tenderness, often great: the pain may run in the course of the great sciatic or anterior crural, and is frequently accompanied by irritability of the bladder, and by pain in the course of the ureter. The condition is liable to be aggravated by exercise. The chief points in the diagnosis of this condition are, Dr. Duncan points out, the absence of blood and pus, the fact that the "aching" often occurs only

at the menstrual periods and is always worse then, from the intimate connection between the kidneys and the generative organs, not only developmental but pathological. A definite nephralgia is also caused sometimes by malaria as pointed out by Morris, and may be relieved by the administration of quinine.

(7) *Interstitial Shrinking Nephritis* This disease may simulate renal calculus both by hæmaturia and pain.

The late Dr S West¹ drew attention to the hæmaturia which may accompany granular kidney, and published three cases, aged 21, 19, and 24, in the first the hæmorrhage was profuse. Sir Anthony Bowlby² also published three cases, aged 73, 43, and 64, two of these died and the kidneys were found markedly granular. He points out the following as distinguishing this condition from renal calculus. The specific gravity of the urine after the blood has cleared up only 1008 to 1015, tortuous arteries, cardiac hypertrophy and high arterial tension, blurred ill-defined discs, some retinitis and effusion amongst the blood vessels. The paper concludes with the following warning: *Unless it be recognised that blood may emanate from a kidney which is simply granular, operations may be undertaken for the removal of renal calculus.*

With regard to renal pain in granular kidney, this is of two kinds. There is the dull aching generally found, if the case be watched to be felt across both loins, as well as in one side. Occasionally though this is rarer, the pain occurs in violent paroxysms simulating renal colic. This was so in the case to which I have alluded, and to a more marked degree in one brought by Mr Mansell Moullin before the Clinical Society.³ If now, in addition to the hæmaturia and paroxysmal pain, there be nausea, passage of uric acid and frequent micturition, the mistaken diagnosis of calculus may easily be made. Where granular kidney is possible, such a case should be carefully watched and, if the specific gravity of the urine never rises above 1010, the question of operation must be entertained with the greatest caution, and the very great risks most clearly put before the patient. On the other hand, many a patient suffering from hæmaturia due to stone has been treated for nephritis, until radiographic or cystoscopic examination has at last revealed the true cause of symptoms. In these cases the absence of casts and of albuminuria, in the interval when there is no blood in the urine, is against nephritis and should lead to further examinations.

(8) *Renal Growths* In these cases pain and hæmaturia are more independent of jolting and other movements, the bleeding is more abundant and it is as little controlled by rest as it is unlikely to be induced by exercise.

Other conditions mentioned by Morris as having been found in some of the above mentioned forty four cases are—small abscesses or suppurating cysts, solid renal or perirenal tumours, tense cysts, blood extravasated either under the capsule or within the substance of the kidney, dense adhesions. To these may be added rare cases of villous tumour of the pelvis, nævus of the pelvis, aneurysm of the renal artery and primary cystic kidney.

B Diseases of other organs which may simulate renal calculus

X ray examinations are very valuable here, and cystoscopy during

¹ *Lancet* 1885, ii 104

² *Clin Soc Trans*, 1887, xx 14

³ *Trans*, 1892, xxv, 60

the actual attack of pain may show that both kidneys are excreting indigo-carmines naturally, thus excluding ureteral obstruction. When little or no pigment issues from one ureter, ureteral or renal disease is very probable.

(1) *Gastric and Duodenal Ulcer.* Morris saw a case of gastric ulcer which simulated renal calculus, and the writer has successfully performed gastro-jejunostomy for an ulcer on the posterior wall of the duodenum which had caused severe pain in the right loin, so closely simulating renal pain that the kidney had been explored.

(2) *Intestinal Adhesions.*¹

(3) *Gall-stones retained in the Gall-bladder* may be taken for right renal calculus. The radiographic shadows may cause or confirm this error: in such a case the writer, having exposed the right kidney and found it to be normal, opened the peritoneum in the loin and removed a large stone from the gall-bladder.

(4) *Spinal Disease.* The great difficulty which may arise in diagnosing between spinal caries and renal calculus is not yet sufficiently recognised. A writer² already quoted thus alludes to this matter:

“Where a local patch of caries of a vertebral body exists, and especially where deep suppuration occurs and presses upon the kidney, as in a case of my own and one or two others which I have seen, nearly all the symptoms of a calculus have been present. In my own case, without any deformity or tenderness of the spine, there was unilateral rigidity, testicular pain, intermission of symptoms, increased frequency of micturition, nausea during attacks and oxaluria, with local pain and tenderness. Subsequently an abscess developed, and on exploration a small patch of caries was found, and the kidney was felt exposed in the anterior wall of the abscess cavity. Probably, as in floating kidney, obstruction of the vessels and ureter may arise and cause symptoms, so that pressure of the spinal abscess may disturb the kidney, and quite possibly give rise to hæmaturia.”

(5) Diseases of the bladder, such as calculus, papilloma, epithelioma or tuberculosis, sometimes mimic the symptoms of renal disease, and fruitless explorations of the kidneys have been undertaken before the real seat of the disease has been discovered to be in the bladder; thus villous growth or epithelioma situated at or near one ureteral orifice may obstruct the latter, and produce spasmodic renal and ureteral pain. A coexisting hæmaturia or pyuria is then erroneously thought to have its origin at the seat of pain in the loin.

Routine use of the cystoscope has done much to prevent the occurrence of such mistakes.

(6) Appendicitis especially when retro-colic may cause symptoms closely simulating those of renal calculus. This is a frequent cause of error; thus a distinguished surgeon considered himself to be the subject of frequent attacks of renal colic, until at last a swelling appeared over the appendix, which was removed; although seventeen years have passed, there has been no recurrence of colic.

In addition to the above, Morris alludes to cases of each of the following conditions giving rise to symptoms simulating renal calculus: malignant and tuberculous growths in the intestines, aortic or celiac aneurysm stretching the ureter or renal vessels, abscess and calculus in the prostate, ovaritis and tuberculous disease of the Fallopian tube.

¹ Sir Nestor Tirard, *Lancet*, 1892, i, 16.

² G. A. Wright, *Med. Chron.*, No. vi, p. 642.

In some cases it may be difficult to decide which kidney to explore, hæmaturia being the main symptom and pain being bilateral indefinite or absent. The cystoscope or the ureteral catheter may then decide the point if skiagraphy and other means have failed to do so. When there are stones in both kidneys or ureters and the renal function is impaired it is generally wise to proceed very cautiously and to remove the stones from the worst kidney or from its ureter first and after an interval to deal with the opposite side. The reverse plan may lead to suppression of urine.

Operation. The patient is placed on the sound side with an air cushion or other support under the flank, the lower thigh and knee flexed and the upper arm secured on a comfortable rest to prevent the body rolling forwards. The surgeon defines carefully the lower border and length of the last rib. That this is not an unimportant detail in renal operations is proved by the following.

Prof. Dumreicher¹ of Vienna accidentally opened the pleural cavity during an attempt to remove a pyonephrotic calculous kidney. At the necropsy it was found that the last rib was rudimentary, that the pleura projected a good deal below the lower edge of the eleventh rib and that thus, when the incision was carried upwards the accident had become unavoidable. Dr. Lange² of New York has called attention to the investigations of Dr. Hüll³ of Vienna on the frequency of rudimentary development of the last rib and the importance therefore of counting the ribs before intended operations on the kidney. Dr. Lange² himself shows that in some cases, which are however exceptional even normal development of the twelfth rib may demand extreme caution, as the pleura may project considerably below it.⁴

The surgeon, having defined the length and position of the lowest rib, makes an oblique incision⁵ at least 1 inch long $\frac{1}{2}$ inch below and parallel to it, beginning about $2\frac{1}{2}$ inches from the spine and a little internal to the angle formed by the last rib and the erector spinae. Some surgeons prefer the curved incision with its inner end ascending over the last rib as indicated in Fig. 272, others choose a vertical or T shaped incision. The incision is kept well above the crest of the ilium, otherwise it is difficult to close. The skin and fascia being divided, the muscles viz. anterior fibres of the latissimus dorsi, the external and internal oblique are cut through by light sweeps of the knife. As soon as the yellowish white lumbar fascia is reached any bleeding vessels which have been temporarily secured by forceps are tied. The lumbar fascia is next incised near the posterior end of the wound, thus exposing the quadratus lumborum and extraperitoneal fat. If the last dorsal nerve cross the incision it, together with its accompanying vessels should be drawn aside or left untouched if possible. While the peritoneum is pushed forwards with the fingers of the left hand, the incision in the muscles and fascia is prolonged to the required extent. The perirenal fat, covered by the thin perirenal

¹ Quoted by Dr. Lange. *Ibid.* *J. Surg.* 1886, ii, 286.

² Dr. Hüll found it at quite a considerable percentage the last rib is so abnormally short that it does not reach as far as the outer border of the sacro-lumbal or so rudimentary that in some cases it more resembles a transverse process and that in these cases the lower edge of the pleura passes from the lower boundary of the last dorsal vertebra almost horizontally towards the lower edge of the eleventh rib.

³ *Loc. supra cit.*

⁴ In other cases the reverse condition may be present, though the last rib be rudimentary the pleura may pass from the lower edge of the eleventh dorsal vertebra horizontally towards the eleventh rib and thus be altogether out of danger.

⁵ I prefer this to any other incision, for it gives a direct and free access without material risk of hernia.

fascia, now bulges into the wound and is incised at the upper and inner corner of the wound, so as to avoid wounding the peritoneum which is in front and the colon which is below. The lower border of the last rib is defined and the rib mobilised by dividing the ligamentum arcuatum externum after pushing up or protecting with the finger the pleura which may lie in front of it. With two large retractors opening up the wound, the surgeon, keeping near the inner angle of the wound, cuts through the fat¹ till he can see, or easily feel, the posterior surface of the kidney, which he carefully separates from its bed of fat by sweeping his fingers around it in contact with its fibrous capsule. No attempt is made to deliver the kidney until this separation is complete. During this first stage of the operation the surgeon will find sometimes that the muscles are much

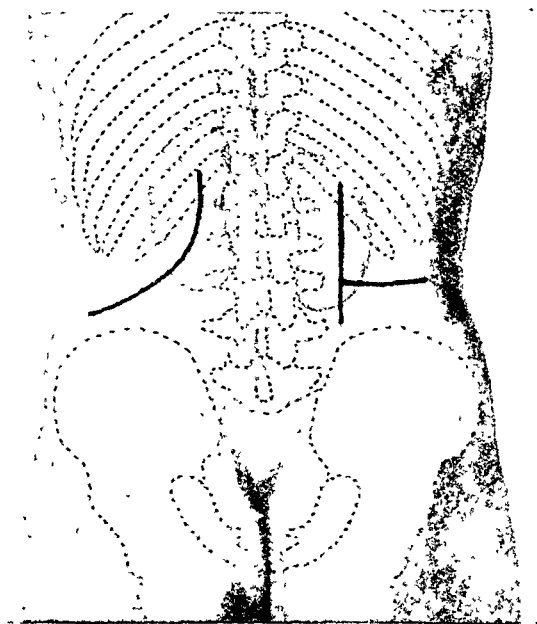


FIG. 272. Nephro-lithotomy. Incisions for retroperitoneal exposure of the kidney.

thickened by reflex irritation from the presence of the stone, and, if the stone has been associated with suppuration and perirenal inflammation, the tissues will be more or less densely blended and matted together.

An assistant now presses on the abdomen, so as to push the kidney up into the wound, this being widely opened by full-sized retractors, aided, if needful, by an assistant pulling up the lower ribs with his hand. Thus the surgeon is enabled to deliver and examine the organ systematically. The assistant holds it while the surgeon feels and inspects the posterior surface and especially the posterior aspect of the pelvis and ureter, then passes the finger round the outer border to the anterior surface, which, as Sir Henry Howse has pointed out,² can be done effectually by pressing

¹ If this fat is very abundant, some of it should be carefully removed; poorly vitalised, it is prone to suppurate tediously and to delay healing, when the urine is septic.

² *Clin. Soc. Trans.*, xvi, 93.

the kidney back against the firm, unyielding psoas. The sensation given by a stone has been compared to that of the uncut end of a pencil (Morris), or the last joint of a finger (Howse).

If the above means fail the incision must be made sufficiently free, especially in a fat patient and a deep loin, to expose the kidney more thoroughly. Additional room may be gained by enlarging the wound at both ends and incising upwards the part of the lumbar fascia which covers the posterior surface of the quadratus muscle, or by making use of König's incision, in which the muscles are cut through as far as the rectus and the peritoneum pushed forwards, or as recommended by Morris,

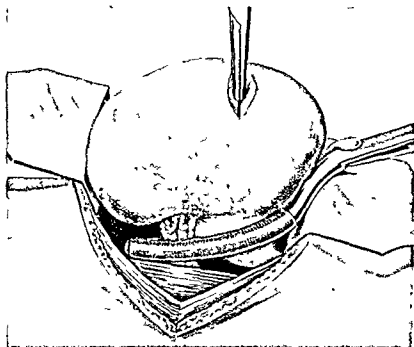


FIG. 273. The right kidney exposed and its vessels clamped while a stone is removed. The cortical incision is transverse. When the stone is large the incision has to be made longitudinally a little behind the free border of the kidney.

continuing the original incision downwards and forwards to a point one inch above and in front of the anterior superior iliac spine. Morris¹ also sometimes removed the distal two or three inches of the twelfth rib, subperiosteally, after exposing its outer surface through a vertical incision carried upwards from the oblique one. I have never had to do this. He also incised the quadratus lumborum if the muscle was broad and obstructed the view. A small stone in the kidney will always be liable to be overlooked, but a surgeon does not give his patient or himself a fair chance who is content with exposing part of the kidney through a limited incision, and then trusting to punctures with a needle. In every case the pelvis and upper ureter must be examined, and the cause of the stone

¹ *Surg. Diseases of the Kidney and Ureter*, 1901, ii, 185 and -93.

formation may be discovered in this way ; obstruction of the ureter by an abnormal renal vessel, valve or stricture is not uncommonly found and can be corrected.

When the kidney cannot be brought out on to the loin, the incision should be made large enough to see what is being done. . Needling a doubtful spot sometimes serves to locate a stone.

Failing all these methods, and if the radiogram indicates a stone, the kidney itself or the pelvis must be incised and explored with a sound and the finger (*see* Fig. 273). Radiographic examination by means of a portable apparatus is invaluable in difficult cases. During this part of the operation, hæmorrhage is prevented either by compressing the renal vessels between the left thumb and index finger or, as advised by Cumston, of Boston,¹ by means of a special rubber-covered curved clamp which he has devised for the purpose. Cumston finds that pressure may be kept up by this means as long as half an hour without harm resulting, the operation being accomplished without any loss of blood. Morris² made a small cortical incision, which the exploring finger fills and even distends, thus controlling the bleeding to a great extent during the exploration. Sir J. Thomson-Walker often uses two short longitudinal incisions just behind the convex border near the poles of the kidney, preferring these to a simple large incision, which may be followed by severe hæmorrhage. A thorough and systematic examination of each calyx is carried out by means of the index finger or a short-beaked bladder-sound. The position of the calculus having been made out, it is removed, if small, through the incision in the convex border of the kidney. If this is inconvenient or the stone large, an incision is made directly over it, and the stone then removed.

PYELO-LITHOTOMY

Unless an incision through the cortex has been already made a small or moderate sized pelvic stone is best removed by a small pelvic incision made near the kidney and afterwards sewn up without narrowing the origin of the ureter (*see* Fig. 274). Fine catgut is always used, for permanent sutures form nuclei for stones. The neighbouring fat or a flap of the fibrous renal capsule is sewn over the pelvic incision to prevent leakage, as recommended by Sir J. Thomson-Walker.³ This operation of pyelo-lithotomy when used for suitable cases is far better and safer than nephro-lithotomy. It damages the kidney less and carries less risk of hæmorrhage both during and after the operation. When properly done there is very little risk of fistula following it. It is not suitable for large or cortical stones or when the kidney cannot be delivered. A large pelvic stone branching into the calyces is best removed through the cortex in order to run less risk of prolonged fistula, although a cortical wound carries with it far more risk of hæmorrhage.

If the stone is irregularly branched, some laceration of the kidney tissue may be spared if the calculus is broken up and removed in two or more fragments. Sir Henry Morris⁴ thus alluded to two difficulties which these stones may cause : " A large branched calculus may be so

¹ *Ann. of Surg.*, 1897, xxvi, 320.

² *Surg. Diseases of the Kidney and Ureter*, 1901, ii, 187.

³ *Genito-Urinary Surgery*, 1914, p. 274.

⁴ *Brit. Med. Journ.*, November 16, 1889.

tightly embraced by the kidney substance and the kidney may be so uniformly even on its surface that nothing more than a very firm tough organ may be thought to be present and even on passing a needle into it no sense of calculus but rather the resistance of a tough fibroma is met with. In these cases much difficulty will be experienced in freeing the stone from its encasement and for this purpose the moderately free use of a bistoury will be requisite. It is astonishing how some of the large branches of a calculus may escape detection unless the surgeon is aware of the firmness with which they are embraced by the tough renal tissue. After removing several large pieces of calculus I have in one or two cases thought that all must have come away because with my finger in the kidney nothing but renal tissue could be felt and yet after scratching through at some points where the resistance was greater than elsewhere branch after branch of calculus has been exposed showing that more

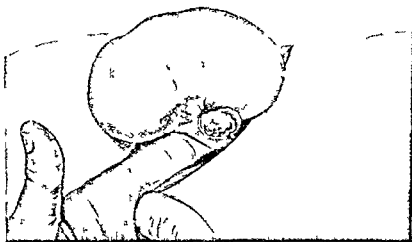


FIG. 74. Pyelo-lithotomy. Stone in pelvis. Kidney delivered and pelvis held up by finger which is in position until the incision has been closed with fine catgut and covered with a flap of capsule or fat.

of the calculus would have been left behind than had been removed had the operation been discontinued because no further actual contact with the calculus was made with the finger in the interior of the kidney. A good radiogram should be before the surgeon as he seeks the stones.

If the kidney be enlarged with expanded calyces the result of calculous hydronephrosis or pyonephrosis on searching through the pelvis for a stone the gush of liquid and collapse of the expanded kidney may cause the stone to disappear into a calyx and thus lead to much trouble in its removal.¹

Sir Henry Morris² gives two other conditions which may prove embarrassing. Sometimes in feeling over the kidney a portion of it varying in size from a sixpenny to a five shilling piece or more is found soft flaccid thin or fluctuating and there is nowhere any sense of hardness

¹ Sir Charles Symonds *Clin Soc Trans* xvi: 181

² *Loc supra cit*

or increased resistance, such as might be expected from even a phosphatic stone. On incising or puncturing this soft part, pus or purulent urine is drawn off, but no stone is felt; but on introducing the finger into the interior of such an organ, a small calculus may be detected, freely movable within an enlarged pelvis, or fixed in a dilated calyx, or possibly at the apex of a funnel-shaped pelvis. Such cases show that aspiration or simple incision and drainage are insufficient, and that one ought not to be satisfied with anything less than a digital examination of the interior of the pelvis, of the calyces and commencement of the ureter. Another arrangement of the calculus is sometimes found in sacculated kidneys. The renal cavity may be wholly or partially filled by a soft, mortary, phosphatic calculus which gives no sound or resistance to the scalpel or trocar, and yet, on incising the renal substance and inserting the finger, a stone of considerable size may be felt."

One more difficulty, which must, however, I think, be a very rare one, is inability to reach the pelvis in a stout patient. Mr. Mansell Moullin relates ¹ a case of this kind.

If after free incision and thorough exploration of the kidney no stone is found, the ureter must next be explored throughout its whole length by passing a No. 3 English bougie or catheter down into the bladder. Morris advised that this step be taken in all cases, whether a stone has been found in the kidney or not; this is certainly a wise thing to do. Urine or injected coloured solution should be withdrawn by the catheter from the bladder; the surgeon is then certain that the passage is clear. The catheter may be passed through the incision in the kidney into the ureter. If, however, the orifice of the ureter cannot be hit off in this way, a small puncture is made in the posterior aspect of the infundibulum, through which the catheter can be more easily passed into the ureter. After the exploration this incision can be closed by a catgut suture.

Should a stone be found to be impacted in the upper ureter, it must now be exposed and removed, the original oblique incision being prolonged downwards and inwards to the required extent, but it is not wise to attempt to remove in this way stones below the pelvic brim. For these I prefer to make an incision in front through the *linea semilunaris*, displacing inwards the rectus muscle and peritoneum, for this is safer and easier.

Since the ureter is frequently dilated behind a stone, after the calculus has been reached with the finger, it can generally be gradually pushed up the dilated ureter towards the kidney. If possible this should be done for two reasons: in the first place, the higher in the ureter the more accessible will this structure be for removal of the stone and suture; and, secondly, damage to a portion of the ureter already probably inflamed or ulcerated by the calculus will be avoided, and thus more rapid healing ensured.

In order to remove the stone the ureter must be incised over it in a longitudinal direction with a sharp knife. The wound in the ureter is then immediately closed by means of catgut sutures passing through the outer coats only, the number of sutures depending on the size of the incision in the ureter. Incisions made into the kidney usually can be sutured also. When, however, the kidney substance has been much

¹ *Clin. Soc. Trans.*, 1892, xxv, 57.

are better dispensed with. For incisions into the pelvis, Lembert sutures of fine catgut are employed. Incisions in the renal parenchyma may be closed in the following manner. Several sutures of medium sized catgut are used (if too fine, they will cut through). They are passed deeply through the kidney by means of long curved round needles, three to five sutures being used, according to the size of the incision. Several mattress sutures may be added to prevent or arrest hæmorrhage (Fig. 275).

These sutures are passed and tied before the compression of the renal vessels is relaxed. Cumston¹ suturing the kidney before removing his clamp. In this way two very important advantages are gained—the prevention of hæmorrhage from the kidney and usually the prevention

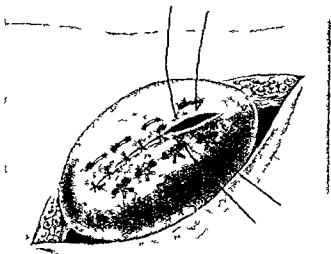


FIG. 275. Nephro-lithotomy. Suture of renal wound. The mattress sutures of thick catgut are hæmostatic; the finer sutures bring the edges of the wound into apposition.

of leakage of urine. The result is that primary union of the incisions generally takes place, and rapid healing of the whole wound and early convalescence are thus ensured.

A drainage tube is now passed from the posterior angle of the wound down towards the kidney or the incision in the pelvis in order to allow of free drainage should leakage of urine occur. In rare cases the tube must reach the interior of the renal pelvis. The rest of the wound is then closed with two continuous catgut sutures (No. 2) for the muscles and a continuous fine linen thread for the skin. In suppurative or tuberculous disease, tension sutures piercing all the parietes must be added for safety.

After-treatment. (1) The patient's attitude in bed should be recumbent but with pillows placed behind the shoulder and ilium of the affected side, pressure on the wound is thus avoided. Later he may be propped up for better drainage along the ureter. (2) The dressings are changed

¹ *Loc. supra cit.*

the pelvis (4) Matting of the parts around the kidney, rendering it difficult to explore this organ its different parts and relations exactly (5) An indurated condition of the kidney itself from the irritation of a stone (6) Troublesome flatulent distension of the colon This is not at all uncommon The bowel should be packed away with a gauze roll pushed deeply into the front of the wound one end of the gauze is always clipped to the towels (7) Opening the peritoneum This accident occasionally occurs in difficult cases If the wound be carefully sutured, there will be no serious consequences (8) A stone present but very difficult to detect This may be due to its small size especially if it lies deeply in a calyx or is surrounded by very indurated kidney tissue A very small stone may cause severe symptoms

Thus in one case a stone weighing but fourteen grains and situated in the top of the ureter quite incapacitated the patient from any work In another case a very small stone firmly fixed in a calyx at the upper part of the kidney caused severe hæmaturia and pain

The following case, under the care of Dr Murphy of Sunderland¹ shows still more clearly what urgent symptoms a tiny calculus may cause

The patient aged 39 had been a complete invalid for nine months owing to repeated attacks of renal colic which morphine failed to relieve the administration of chloroform being frequently required At the operation a very small stone about the size of a hemp seed escaped with a flush of blood when the kidney was incised The site of the stone is not given A good recovery followed

How impossible it is to detect some stones is shown by a case published by Morris²

This authority with all his experience after thoroughly examining the kidney compressing it all over with the finger and thumb and also after puncturing it failed to detect a stone which lay in a hollowed out calyx Though the calculus was the size of a small marble it was so thickly surrounded by kidney tissue that even after the removal of the kidney the position of the stone could not be detected by pressing on the kidney with the fingers as it lay on a table The patient made a good recovery

Another difficulty may occur with a sacculated kidney into one of the sacculi of which a small stone may fall and be hard to find

(9) A stone on the anterior surface of the kidney especially if near the entrance of the vessels

(10) A very large or a branching stone Mere size does not necessarily create difficulties in extraction though owing to the changes entailed in the kidneys the general health, &c by the long duration of a calculus the prognosis is rendered very much less favourable A branched calculus presents, of course, much greater difficulties

Bennett May has published³ an excellent instance of this kind in which he successfully removed a very large somewhat S-shaped calculus from a man aged 74 with symptoms of sixteen years duration Though the stone weighed 473 grains and was three inches long manipulation failed to make it out distinctly but acupuncture detected it at once

Footner of Tunbridge Wells removed a calculus weighing 822 grains or nearly

¹ *Brit Med Journ* 1891 i 757

² *Med Chir Trans* xlviii 69 The woodcut (p 73) shows well the relation of the stone to the surrounding kidney

³ *Clin Soc Trans* xvi 90

two ounces. The patient made a good recovery, but a sinus persisted, through which, on two occasions, a millet-seed calculus was passed.¹ A calculus far exceeding the above was brought by D. Day, of Norwich, before the Clinical Society.² This calculus, mainly phosphatic, weighed 1.331 grains. The patient made a good recovery, with a sinus persisting in the loin. A calculus larger than either of these is mentioned at p. 532.

(11) A stone which breaks up rapidly. Another condition allied in difficulty is where a calculous deposit rather than a distinct calculus is present. This is more grave, as the deposit here will usually be phosphatic and point to coexisting pyo-nephrosis.

(12) Multiple calculi. Stones (usually minute in size) numbering over 60 or 100 have been removed on several occasions. In such cases it is always possible that the minute calculi have been retained, owing to a larger calculus, *e.g.* in the pelvis or ureter, blocking their exit.

(13) A very mobile kidney. The importance of delivering the kidney has already been insisted on. It is essential to have this done both for detection of the stone and for its removal, in order to avoid needless disturbance of the surrounding parts.

May³ explains the remarkable fact that his large stone was not felt when the kidney was thoroughly exposed by the fact that the organ fell forwards and thus embarrassingly increased the depth of the wound.

(14) A kidney situated very high up under the ribs, especially if there be firm adhesions around it. In such a case, it may be necessary to remove the distal two-thirds of the last rib, care being taken to protect the pleura.

(15) A kidney, the pelvis of which it is difficult to reach owing to the stoutness of the patient.

Question of Nephrectomy during a Nephro-lithotomy. In several of the above conditions the question of the advisability of removal of the kidney will arise, *e.g.* where the kidney has been much handled and repeatedly incised, where the stone is large and branched and difficult of removal, where many stones are present or where one is present and very friable, where the kidney is much altered by pyo- or hydro-nephrosis.

In such cases the surgeon will be guided by the age of the patient; the knowledge he possesses as to the condition and function of the other kidney (the amount of urine, &c.); the proportion of the urea excreted by each kidney, the evidence of skiagraphy of the opposite kidney, &c., the degree to which the kidney he is operating on has been disturbed from its relations, and its structure interfered with; the amount of disease, *e.g.* number of sacculi, condition of pus contained in them, the thinning of the cortex, &c. Finally, the length of time that the operation of nephro-lithotomy has already lasted and the condition of the patient must be taken into account. Where the patient is young, where the other kidney is healthy, where the kidney operated on is much damaged by previous disease, where several stones are present, nephrectomy, either now or a little later, is indicated; of these, immediate removal of the kidney is preferable if the patient's condition admits of it.⁴ But the

¹ *Brit. Med. Journ.*, 1892, ii, 69.

² *Trans.*, 1893, xxvi, 24.

³ *Loc. supra cit.*

⁴ W. H. A. Jacobson, *Clinical Soc. Transactions*, 1889, xxii, 198; and 1891, xxiv, 155.

question is a very different one where the kidney is large after its fluid contents as well as a stone have been removed, or where it is a case of multiple calculi in a suppurating damaged kidney. Nephrectomy should as a rule be deferred here and the kidney thoroughly drained for (1) additional shock and loss of blood will be avoided (2) the condition of the opposite kidney, very possibly calculous also will be made clearer by waiting, (3) the bulk of the kidney will be lessened by drainage, (4) though a source of discomfort (if an open sinus persist) it may still do some important work. Occasionally carcinoma develops in a calculous kidney and may be suspected where there is unusual induration of the kidney or pelvis around the stone. The author found this condition in a man aged 65 who had had a stone in the left kidney for over 40 years. The shadow of the stone extended from the eleventh rib to the crest of the ilium. The patient died of recurrence of the growth within a year of the nephrectomy.

Results. In 1024 cases at the Mayo Clinic¹ the mortality was 1.06 per cent. Recurrence took place in the same kidney in 8.5 per cent. In Leguen's² collection of 264 nephro lithotomies the death rate was 6.4 per cent.

Causes of Death after Nephro-lithotomy

(1) *Hæmorrhage*. A most interesting case of hæmorrhage fatal on the seventh day after nephro lithotomy was brought before the Clinical Society³ by Dr Stevenson and Mr Butler Smythe.

Several small and one larger stone (this one being tightly fixed in the pelvis and ureter) having been removed from a kidney the site of hydro nephrosis the patient did well save for a temperature which was 103° on the third and fifth days and all along very variable until the sixth day when bright blood and urine were passed both by the urethra and by the wound. On the seventh day about half a pint of bright bloody urine was drawn off from the bladder and death took place soon after with symptoms of internal hæmorrhage. The kidney was found enormously distended with blood-clot and bloody urine. The opening made at the operation was small and blocked up by clot. Embedded in the kidney substance close to the pelvis was a round spiked calculus which had ulcerated into a branch of the renal artery just at its entrance into the kidney and had given rise to profuse bleeding into this dilated organ.

Another possible cause of hæmorrhage after nephro lithotomy is where calculi are associated with a growth in the pelvis of the kidney. Mr Battle has recorded a most interesting instance of this.⁴

At a lumbar nephro-lithotomy several oxalate calculi were removed and a villous growth scraped away from the lower anterior aspect of the pelvis. The patient resumed work but the hæmaturia returned and became profuse and constant and the kidney was removed about eighteen months after the first operation. The surface about the pelvis was papillated and firm and the microscope showed evidence of a new growth at this spot but whether this was a simple papilloma or a squamous epithelioma remained doubtful.

Hæmorrhage may be treated by tightly packing the wound and applying firm pressure. Nephrectomy may have to be done in a few cases.

(2) *Shock*. This may be lessened by bandaging the limbs firmly over

¹ E. S. Judd and A. J. Scholl *Collected Papers of the Mayo Clinic* 1914 xvi, 31.

² S. J. Thomson Walker *Carson's Modern Op. Surgery* 11 59.

³ *Trans.* 1889 xxii 914.

⁴ *Brit. Med. Journ.* 1895 i 106.

gamgee tissue before an operation which is expected to be difficult and tedious. It may be combated by saline infusion, warmth and injections of pituitrin.

(3) *Cellulitis*.

(4) *Uraemia*. if the other kidney is the site of calculous disease or disorganised. Years ago this was a common cause of death.¹ Modern methods of examination and preparation have done much to diminish the number of deaths from uraemia.

(5) *Septicæmia*. It is to be noted that septicæmia may occur after a nephro-lithotomy, successful as far as the removal of the stone goes, after a considerable interval, where pyo-nephrosis coexists. This is an additional reason for carefully considering the advisability of performing nephrectomy in such cases.

Dr. Shepherd, of Montreal, has published ² a very interesting instance of this kind :

Nephro-lithotomy was performed in a patient aged 26, who had suffered from symptoms of stone for seven years, with no tumour, and pus in the urine. An enormous, unbreakable stone of triple phosphate was removed with much difficulty from the left kidney. It weighed 4 oz. 7 dr., and measured 3½ inches in length and 9 inches in circumference. The tissue of the lower part of the kidney exposed seemed healthy, and no pus being evacuated it was thought best not to remove the organ. The wound continued to discharge pus, and the temperature varied correspondingly for three months and a half after the operation, when septicæmia set in and proved fatal. The necropsy showed that the upper part of the kidney, which was not exposed, consisted of large communicating sacs, containing over 10 oz. of fetid pus, and a number of irregular branched calculi. Dr. Shepherd points out that the fatal septicæmia was undoubtedly due to these abscesses, showing the need of thorough exploration in all cases where a large stone has set up grave changes, and of extirpation in most of them.

THE TREATMENT OF CALCULOUS ANURIA

Although spontaneous recovery from this very grave condition may occasionally occur, it is certain that an early and suitable operation is by far the best treatment. Morris ³ found that only 20·8 per cent. cures occurred in 48 cases treated without operation, whereas 51 per cent. out of 49 cases recovered after operation. Out of 56 cases collected by Legueu, 28·5 per cent. recovered without operation ; it is probable that the obstruction was never complete in some of these cases.

Before operating, the surgeon should remember, that the stone is nearly always in the ureter of the only useful kidney, but that both ureters may become simultaneously obstructed in some cases, and also that two exceptional cases have been recorded in which a vesical stone closed the orifices of both ureters.⁴ Morris drew attention to the three important factors in the production of calculous anuria.

(1) " A long-standing change in one of the kidneys causing a diminution if not suppression of its function ; or else a congenital anomaly (absence or atrophy).

¹ *Chin. Soc. Trans.*, xv, 123.

² *Philadelphia News*, April 23, 1887 ; *Ann. of Surg.*, 1887, vi, 185. The right kidney is stated to have been perfectly healthy, but double its normal size.

³ *Surg. Diseases of the Kidney and Ureter*, 1901, ii, 159.

⁴ Morris, *loc. cit.*

(2) A recent or recently aggravated lesion of the principal kidney. This lesion is mechanical and caused by a calculus.

(3) A reflex inhibitory effect upon the disorganised kidney leading to complete suppression of its imperfect functional power.

The surgeon may restore the function of the principal kidney by a prompt removal of the obstructing stone or failing this by simply forming a temporary fistula in the loin the other kidney may then regain its use.

Diagnosis. Calculous anuria can be readily distinguished from the temporary reflex suppression that may follow operations on the lower urinary organs by the history and from the uræmia of Bright's disease also by the history and by the absence of the early and characteristic symptoms of non obstructive uræmia such as headache nervous disturbances coma and convulsions. The subject of calculous anuria may remain so well for many days that it may be difficult to realise the gravity of his condition.

It is not always easy to tell the side of the principal kidney and the exact position of the calculus which has recently obstructed its ureter but every effort must be made to determine these points for the operation must be performed on the side of the healthiest kidney which is nearly always the last affected.

A history of previous attacks of renal colic on one side and of a sudden recent onset of colic on the same side associated or rapidly followed by anuria may indicate the affected side with more or less certainty but if the last attack of colic which has been followed by anuria be on the other side the obstruction is practically certain to be on that side. Rigidity tenderness and more rarely swelling on one side may confirm the diagnosis.

When no history of value is available palpation may discover tenderness or rigidity over one kidney or ureter although the subjects of anuria are usually too stout to allow palpation of the ureter. Rectal and vaginal examination may enable the surgeon to feel a calculus low down and Morris detected a stone in the ureteral orifice after dilating the female urethra and such a calculus has also been seen through the cystoscope. Examination of the ureteral orifices by means of this instrument may add a link to the chain of facts required for accurate diagnosis. In cases of partial anuria the cystoscope may serve to show which kidney is the principal one especially when indigo carmine has been injected into a vein.

Catheterisation of the ureter may demonstrate the affected side and the exact position of the stone it may even displace the stone and relieve the anuria.

If one kidney is known to have been diseased for some time and especially if it has been explored by an operation the recent obstruction is almost certain to be on the opposite side. When one kidney has been removed and anuria suddenly supervenes some time afterwards it is imperative to explore the remaining kidney but this has not always been done. Thus a young woman had her left kidney removed for tuberculous disease some months later she was taken to another hospital suffering from anuria which was considered to be due to tuberculous disease of the remaining kidney but the autopsy disclosed a small calculus impacted in the right ureter and a hypertrophied healthy kidney.

With certain precautions, radiography may give information which may serve to complete the diagnosis by localising the stone, but a negative result must not be relied upon, because a stone which is large enough to obstruct the ureter may yet be too small or too transparent (uratic) to give a shadow in a fat subject. A positive result may also mislead, for a large calculus may be present in the pelvis of the other kidney, and only a small one in the ureter last obstructed. To arrive at a diagnosis, all the facts available must be reviewed and too much reliance must not be placed upon any one sign.

It must not be forgotten that cancer of the uterus or of the bladder may, rarely, cause sudden anuria, and lead to a hasty diagnosis of calculous anuria, but a thorough examination ought to prevent this mistake.

Morris related a case of polycystic disease of both kidneys, which led to error. A history of passing gravel and a stone was very misleading in this case.¹ Anuria may be the last stage of any renal disease, especially of bilateral tuberculous or calculous nephritis.

The Nature of the Operation. In most cases it is best to explore the kidney which is considered to be the principal one through the usual incision in the loin, and to remove any stone that may be discovered in the pelvis or the upper part of the ureter. Morris stated that in twenty out of thirty cases this incision would have served to remove the calculus at the primary operation. If a calculus cannot be found in this way, a ureteral catheter should be passed downwards to locate it. Sometimes it may be removed by prolonging the incision, or through a separate extra-peritoneal incision in the groin, if the calculus is lower down. In grave and late cases, however, it will be wise not to endanger the life of the patient by prolonging the operation unnecessarily, and to defer what may prove to be a difficult and long operation until the patient has recovered from his immediate danger: by forming a fistula the surgeon will have done all that is urgently required to save life, *i.e.* to re-establish the secretion of urine. The best way is to open and drain the renal pelvis, for nephrostomy may be followed by severe hæmorrhage² in these cases where the kidney is much enlarged and congested.

If it be known beforehand that the stone is too low to be reached from the loin, extra-peritoneal ureterotomy after displacing inwards the lower half of the corresponding rectus abdominis should be performed at once, the stone removed through a longitudinal incision and a catheter passed down into the bladder to make certain that the passage is clear. The incision into the ureter may be partly closed by catgut sutures, but it is not safe to invert the edges and thus to narrow the lumen of the only ureter, unless the latter be dilated at the site of the incision.

Blood clot in the lower part of the ureter may be sufficient to prevent or delay the return of urinary secretion, as pointed out by Clayton Greene.³ In any case a drain must be placed near the ureter to prevent possible urinary extravasation.

If the stone be known to be impacted at or near the lower end of the ureter, primary nephrostomy may be done in grave cases, and the calculus may be removed later, if not naturally passed.

¹ *Loc. supra cit.*, ii, 168.

² Melon, *Journ. Amer. Med. Assoc.*, February 16, 1924, p. 520.

³ *Lancet*, 1906, i, 91.

Garceau¹ removed a stone which was impacted near the lower end of the ureter through an incision in the anterior vaginal wall. The operation only took ten minutes, and it was completely successful.

Sometimes, although very rarely, it may happen that all the efforts of the surgeon may not suffice to enable him to decide upon which kidney to operate. He must then explore one kidney through the loin and if this be found to be atrophied or greatly diseased he must drain the opposite kidney and remove the obstruction if possible. This is better than doing an exploratory laparotomy for it may be very difficult to find and examine the ureters, especially in fat subjects, and even if a calculus be found it is not wise to try to remove it through the peritoneum for several reasons. The contents of the ureter above the stone are very likely to be septic, and it may be necessary to drain the ureter, which is more safely done extra peritoneally, if the incised ureter be sewn up it may leak into the peritoneum later. Moreover, palpation of the kidneys may mislead the surgeon, the largest kidney being the most diseased one in some cases. Even if a correct diagnosis be arrived at by a laparotomy another incision is necessary to drain the kidney and remove the calculus, as in Duke's case². In this case all that the surgeon could discover with his hand in the abdomen was that the right kidney 'was apparently a little larger than the left'. On this slight evidence the right kidney was opened through the loin and two calculi discovered in the pelvis: one of these, weighing 3.2 grains, was removed later, and the patient recovered, although she had suffered from complete anuria for ten days.

Cabot advocates exploratory laparotomy,³ if other methods fail to indicate the site of the recent obstruction. He relates two very interesting cases, in each of which the operation failed to discover the calculus, but probably served to dislodge it. In one case bimanual examination through a median laparotomy and an incision in the loin failed to discover the calculous obstruction. In the other patient only a lumbar nephrotomy was performed. Both patients recovered.

One of the most brilliant examples of what nephro lithotomy can do in some cases of calculous anuria was brought by R. C. Lucas before the Medico Chirurgical Society⁴ and before the International Congress of Medicine meeting in London about twenty eight years later.

The patient, aged 37, had had her right kidney, a 'mere shell containing masses of stone weighing twenty one ounces' successfully removed in 1885. Three months later she was seized with agonising pain in the back and left loin. Suppression of urine quickly set in and on the fifth day a calculus was removed which was exactly of the shape to act as a ball valve to the top of the left ureter. The patient made an excellent recovery, and was quite well when shown by Lucas at the International Congress in 1913.

But in many cases of suppression the indications are less clear, and there is often much difficulty in deciding which ureter is blocked, owing to the deficient history. An excellent instance of such cases, in which the surrounding difficulties were most successfully met is recorded by Fraser and Parkin, of Hull.⁵

¹ *Boston Med and Surg Journ*, April 21, 1904.

² *Lancet* 1904 ii 174.

³ *Ann of Surg*, October 1904.

⁴ *Trans*, lxxiv, 129.

⁵ *Lancet*, 1893, ii, 688.

The patient here suffering from suppression of urine was 74 years of age. Beyond the evidence pointing to obstructive anuria, there was very little to throw light on the condition of the kidneys, or which organ should be explored. As the patient had been observed by her friends to support the left side in walking, and as there was deep-seated tenderness in this loin, Parkin explored the left kidney from the loin. The organ was enlarged, distended, and hypertrophied. About six ounces of urine escaped when the kidney was incised along its convex border, the last portion to come away being mixed with some pus. No stone was found and the cause of the suppression must remain obscure, as the patient, though 74, made a good recovery, with a sinus from which most of the urine passed.

The above cases show the importance of knowing the history and, where this is deficient, making a most minute examination, no point being considered too trivial to be pieced in with others, before it is decided which kidney is the working one and now obstructed, and which is obsolete.

The Time for Operation. Any operative interference should be undertaken, if possible, long before the final stage of constant hiccough and vomiting, subnormal temperature, irregular pulse, tremor and drowsiness. As soon as the diagnosis becomes certain an operation should be resorted to, for it must be remembered that, if the obstruction be too long continued, its removal may not relieve the suppression. The mortality mounts steadily with the delay. A few patients have recovered after suffering from complete anuria for ten or more days, but others have died after three or four days. Cases of incomplete obstruction last much longer.

One of us (R. P. R.) removed two small stones from the left ureter of a very stout lady who had suffered from anuria for eight days. She was greatly distended, vomiting brown offensive material. She was dyspnoic and cyanosed. She made a good recovery and remembers little or nothing of her grave illness. Within seven hours of the operation she passed six pints of urine laden with urea. She had been given four pints of saline solution in the axillæ. The opposite kidney had probably been destroyed six years earlier by an impacted calculus.

Diuretics, purgatives and sudorifics should also be given.

Anuria following injuries is much less hopeful, owing to concomitant injuries. The following are examples :

Edward Cock recorded ¹ the case of a young man who died comatose on the eleventh day after an accident. All the symptoms of the original injury and the subsequent peritonitis subsided in a few days, save that the catheter withdrew nothing but blood. The autopsy showed a ruptured single kidney. In Poland's case ² the complete suppression of urine which followed an injury was due to thrombosis of the renal vessels of one kidney, and rupture of the pelvis on the other side.

Butler, of Guildford, records ³ a case of suppression of urine lasting thirteen days. The necropsy showed that the ureter of the only working kidney (the left one) was greatly distended with urine and plugged by a solid hard body about its centre. This proved to be a venous thrombus, which, formed in one of the veins in the kidney, had passed through a rent in the kidney tissue into the pelvis and ureter. Here the suppression came on four days after a blow on the abdomen. No symptoms had pointed to renal disease, and, save that the blow was on the left side, there was nothing to tell on which side the obstruction was.

¹ *Path. Soc. Trans.*, 1846-48, i, 293.

² *Guy's Hospital Reports*, vol. xiv.

³ *Lancet*, 1890, i, 79.

NEPHRECTOMY

Indications (1) *Renal tuberculosis* when proved to be unilateral, when the general health and strength of the patient are good enough to warrant the operation and when there is no evidence of active phthisis or of serious tuberculous disease elsewhere. Associated tuberculosis of other parts was found in nearly 80 per cent of 227 cases at the Mayo Clinic¹

Primary nephrectomy is always to be preferred under the above conditions, but occasionally secondary nephrectomy has to be undertaken after the kidney has been temporarily drained and a discharging sinus or urinary symptoms persist and the general health is not improving. Secondary nephrectomy may be more difficult and dangerous owing to the presence of troublesome adhesions and extension of disease into the surrounding tissues. The operation should be performed without delay while the kidney is still comparatively small and movable and before the disease has extended along the ureter or into the bladder. The risk of general tuberculosis is also to be borne in mind. There is no evidence to show that tuberculous disease of the kidney ever heals, although its symptoms and signs may vanish when the kidney has been slowly destroyed and remains only as a fibro-caseous mass, but for the very few that survive this painful and tedious process many more succumb to this most fatal disease. Over thirty years ago Mr Jacobson strongly advocated early operation.

"I would most strongly urge this course (early exploration of the kidney) with a twofold object (1) to clear up the case² and (2) to perform nephrectomy if the kidney is found to be the site of so fatal a disease. If I am told of the unwisdom of this step owing to the probability of both kidneys being affected, I would reply that as a rule both kidneys are not affected at an early stage. Thus Dr Fagge³ gives a list of thirteen cases which show 'the characters of tuberculous disease of the kidney at its commencement'. In only three of these were both kidneys affected, and in all these tubercular mischief was present in the bladder also. If during this early exploration one or two pyelitic dilatations are found, extirpation of the kidney should be performed while the organ is still small and movable, and before the rest of the genito urinary tract becomes involved.

"I need not remind my readers of the miseries which he before a patient with established tubercular kidney, the results of ulceration of his bladder and the usual course downhill arrested it may be for a little while by nephrotomy and drainage."

Mr Jacobson's experience of drainage alone in established tubercular kidney was most unfavourable, the relief being slight and short lived and not arresting long the hectic and increasing debility. On the other hand, in four cases in which he was able to perform nephrectomy early the results were most satisfactory. In four others the recovery though less complete, was very satisfactory. Finally, in two the disease was too advanced for the results to be satisfactory. This was before the modern

¹ V. C. Hunt, *Collected Papers of the Mayo Clinic*, 1923, xv, 429.

² *Brit Med Journ* 1890 i, 117.

³ *Fagge's Medicine*, ii, 488.

methods of early accurate diagnosis were available. These should be employed in every case. The present writer's results in fifteen cases have been very gratifying, although one patient died of general tuberculosis six months after the nephrectomy.

Ramsay¹ gives the results of 191 cases of primary nephrectomy for renal tuberculosis. Of these 106 were noted as cured, 31 were improved, 37 died within one month of the operation, and 17 died at a later period.

Forty-nine cases of secondary nephrectomy after a previous nephrectomy are also given. Of these 18 died shortly after the operation, and 23 (or 46 per cent.) were cured. Of the 37 deaths resulting from primary nephrectomy 9 were due to uræmia, 3 to tuberculosis of the other kidney, and 2 to amyloid degeneration of the other kidney. These 14 deaths serve to emphasise the importance of thorough investigation of the capacity of the other kidney before nephrectomy is decided upon. For although the second kidney, as mentioned above, is not often affected in early cases, yet when the case only comes under observation in the more advanced stages it will very possibly be diseased.

At the Mayo Clinic² the mortality was under 2 per cent. in 227 cases, but another 20 per cent. died within five years after the operation, but 60 per cent. of the patients were cured. H. H. Young³ reports a mortality of 0.89 per cent. in 112 cases, 47.5 per cent. cures and 20 per cent. improvements.

Mr. David Newman⁴ writes as follows on this important subject :

"There is as great responsibility in refusing an operation as in advising one, and by adopting the former course during the time that elapses between the onset of the disease in the kidney and the invasion of other parts the surgeon may allow to escape a valuable opportunity of saving the life of his patient. Since physicians have come to appreciate the value of recognising urinary tuberculosis at an early stage the results obtained by the surgeon have greatly improved."

Now by bacteriological examination of the urine, inoculation experiments, segregation of the urine and the employment of the cystoscope the surgeon can obtain objective proof of the presence of tuberculosis in the urinary tract long before the subjective evidence is sufficient to justify a diagnosis. Unfortunately, when a patient is not suffering much actual pain or serious inconvenience it is difficult to convince him of the seriousness of his condition, but in all cases of primary renal tuberculosis the problem must be seriously placed before him and nephrectomy advised.⁵

"Permit me to quote a passage from Watson and Cunningham :⁶

"*Clinical evidence of unilateral renal tuberculous infection.* The testimony of this nature upon the unilateral occurrence of renal tuberculosis is derived from, and based upon, the examinations of the urines drawn separately from each of the two kidneys, and from the facts with regard to permanency of the cures or entire absence of evidence of the

¹ *Ann. of Surg.*, 1900, xxxii, 461.

² V. C. Hunt, *loc. supra cit.*, and E. S. Judd and A. J. Scholl, *ibid.*, p. 438.

³ *Practice of Urology*, 1926, i, 324.

⁴ *Lancet*, 1912, ii, 1735.

⁵ Newman, "The Surgical Aspects of Early Renal Tuberculosis," *The Practitioner*, July, 1911.

⁶ Newman, *Diseases and Surgery of the Genito-Urinary System*, ii, 390.

existence of renal tuberculosis, subsequent to nephrectomy of the kidney which is known to be invaded by it. Upon the evidence of this character, such surgeons as Kronlein, Israel, Kummel, Rafin, Kelly, Bevan, Reynaud, Casper and Hurry Fenwick assert that the process, at the time at which the patients were examined by them, was confined to one kidney in from 50 to 80 per cent of the cases. Or, taking the disease not at the stage when it should be presented to the surgeon but when it has done its worst and has come under the review of the morbid anatomist rather than the clinical pathologist, Halle and Motz¹ found in 131 cases of renal and ureteral tuberculosis examined by them post mortem, in 89 the disease was confined to one side, in 42 it was bilateral."

Should the condition of the other kidney still remain doubtful after the available methods of investigation have been exhausted, then it may become necessary to examine it by means of an exploratory incision, but if the ureteral catheter can be used the need for this operation can scarcely arise. Edebohl's² advised a lumbar exploration, and this is doubtless the safer and more certain method. The disturbance caused will be comparatively slight and is more than balanced by the additional security that the surgeon will feel when proceeding to perform nephrectomy a week later.

As it is necessary at least to see the kidney in order to be sure that it is healthy, it is clear that an examination through an abdominal incision only serves to show the presence of the kidney. Mr Barling³ however, recommends palpation of the opposite kidney through an incision into the peritoneum at the anterior part of the usual lumbar incision. This plan is certainly simpler than making a separate abdominal or lumbar incision, although it cannot be said to be as reliable as the latter, the eye being much more trustworthy than the hand.

(u) *Calculus pyelitis or pyo nephrosis* where the kidney is destroyed by long formation of calculi and consequent suppuration, where numerous calculi exist with sacculatation of the kidney or where a large and branching calculus is so embedded as to resist removal. These indications for nephrectomy have been already considered under the heading 'Nephrolithotomy' (p 530), as it is during the performance of this operation that the question of removing the kidney for the above conditions will arise.

(iii) *A kidney the site of hydro nephrosis or pyo-nephrosis in which the cause is irremovable, or the kidney beyond hope of recovery*

A papilloma of the renal pelvis may cause a large hydro-nephrosis with destruction of the renal tissue. Reynolds⁴ describes such a case requiring nephrectomy. Albarran and Imbert were only able to collect accounts of twenty two cases. It is possible that early diagnosis may enable the surgeon to save the kidney by removing the growth only, but it should not be forgotten that these growths are very liable to become malignant.

In cases where the hydro nephrosis is early and due to movable kidney nephropexy will often suffice. In some cases the hydro nephrosis

¹ *Annales des Maladies des Organes Génito Urinaires*, Paris, 1906, xxiv, 161, 241.

² *Ann. of Surg.*, April 1898.

³ *Ann. of Surg.*, 1906, xliii, 418.

⁴ *Ann. of Surg.*, 1904, xxxix, 743.

may be due to valve or stricture of the ureter. For an account of the different operations performed for the relief of these conditions, see p. 577.

(iv) *Certain cases of malignant disease.* These fall into several groups, which must be looked at separately from an operative point of view. (a) *Sarcoma* occurs chiefly in children before 10, usually much earlier, before 5. In such cases the risks of immediate death from shock, of early recurrence or of death from secondary deposits elsewhere, should be put clearly before the parents, together with the certainty of an early death if the growth is left.

(b) *Hypernephroma*, the commonest of all renal tumours.

(c) *Carcinoma* occurs usually in patients past middle age.

(d) *Embryonic tumours.*

In addition to these, malignant papilloma of the renal pelvis has to be considered, for it demands nephrectomy and ureterectomy. Darnall¹ analysed 56 recorded cases.

In any case an operation should only be performed in an early stage, while the growth is still inside the capsule, and while the strength, health, and condition of the viscera are satisfactory. On the other hand, where the history makes it probable that the growth has got beyond the earlier stage, when there is any extension to the lumbar glands or other viscera, when there is nausea, emaciation, hæmoptysis or a temperature inclined to fall, the time for operation has gone by. So, too, any ascites or œdema of the lower limb are absolute contra-indications. Varicocele is so uncertain a symptom, that it cannot be held to contra-indicate operation.²

With regard to the frequency of secondary deposits, the fact that Dickinson³ found these to be present in no fewer than 15 out of 19 cases strengthens, very decisively, the argument in favour of early operations while these growths are small, at which time, moreover, they can be successfully attacked through a lumbar incision sufficiently enlarged by the steps given at p. 521, or by one made anteriorly.

Much information may be gained from a very complete study of sarcoma of the kidney in children by Dr. George Walker, of Baltimore.⁴ In all, 74 cases in children in which nephrectomy was performed are here collected. Of these 27 died from the effects of the operation, 28 died from recurrence, 14 passed out of sight, and 4 remained well from three to five years after the operation. The immediate mortality is therefore 36·4 per cent. Though still very high, this is a vast improvement on the earlier published figures; for instance, Butlin⁵ gives 60 per cent. As regards cures, 4 cases, or 5·1 per cent., may be considered as probable cures, but it is quite possible that some of the 14 cases that passed out of sight were cured, since they were all of them well when last heard of; in this case, 5·4 per cent. is too low. Since the publication of this paper one of the supposed "cures" died of recurrence or of independent and similar disease in the other kidney, and 2 incomplete cases have been reported to be well after six and ten years respectively. So that the proportion of

¹ *Surg. Gynec. and Obst.*, 1922, October, p. 493.

² Owen Richards, *Guy's Hospital Reports*, 1905, lix, 217.

³ *Diseases of the Kidney and Urinary Derangements*.

⁴ *Ann. of Surg.*, 1897, xxvi, 529 *et seq.*

⁵ *Oper. Surg. of Malig. Disease*, p. 254.

cures may now be said to be at least 67 per cent. Briefly the most important points in connection with four of these successful cases are as follows

1 *Israel's case* Boy aged 14 years. The tumour about double the size of a man's fist was removed through a T shaped lumbar incision. The perirenal fatty tissue was freely excised after removal of the growth. Well five years later.

2 *Schmidt's case* Girl aged 6 months. The tumour was the size of a child's head and was removed through an incision two fingers breadth to the left of the middle line of the abdomen. The peritoneum was not sutured. The child was well four years later.

3 *Abbe's case* Girl aged 2 years. The tumour which weighed 2½ lbs was removed through a transverse incision extending from the lumbar region to near the middle line of the abdomen. The child was well four years after but she died of sarcoma of the other kidney nine months later.

4 *Abbe's case* Girl 14 months old. A transverse incision was again used extending from the middle line of the abdomen to within 6 cm of the spine. The child weighed 15 lbs the tumour 7½ lbs. The child was well three and a half years later.

Another successful case is described by J. D. Malcolm¹ the child being in good health eighteen years after the operation.

Morris² concludes that the mortality from the operation has been reduced to between 20 and 25 per cent and thinks that it is not likely to fall much lower than this. Fedoroff³ had a mortality of 20.6 per cent in 42 nephrectomies.

Heresco⁴ in his 53 cases in infants operated upon since 1890 found a mortality of only 17 per cent.

Ultimate Results. Over 10 per cent of the adult cases were cured in the sense that they were known to be well at the end of three years and are not known to have had recurrence since although the results are less favourable in children about 7 per cent of cures occurring (Owen Richards).

Dr Walker also compares the length of life from the time of the discovery of the tumour in cases not operated on with those that were operated on. In 68 cases not operated on the average length of life was 8.08 months in the operation cases the average was 16.77 months an average gain that is of 8.69 months by operation.

Since this disease when left to itself is necessarily always fatal a rate of cure after operation of nearly 10 per cent constitutes strong evidence in favour of operation wherever there is a reasonable hope that the whole of the disease can be removed.

With earlier diagnosis and improved technique it is to be hoped that a still greater measure of success will obtain.

To secure this improvement the following points deserve attention. An exploratory incision should be made as soon as obstinate pain and swelling (perhaps revealed by an anæsthetic) or free and recurrent bleeding shown to come from one kidney by means of the cystoscope call attention to the possibility of a growth and before time has elapsed for lymphatic infection. Where the case comes before the surgeon in a more advanced

¹ *Clin Soc Trans* 1894 xxvi 94 and 1895 xxvi 987

² *Surgical Diseases of the Kidney and Ureter* 1901 i 60

³ *Zeitschrift für Urologie* 1901 xvi 333

⁴ *Thèse Paris* 1899 and quote by Owen Richards in an excellent paper in the *Guy's Hospital Reports* vol lix

stage, he should bear Mr. Malcolm's advice in mind. As in the "treatment of new growths elsewhere, the more definite the outline of the tumour, the more mobile it is, the slower its growth, the better the state of the patient's health—in fact, the stronger the evidence that the patient is only locally affected, the more likely is operative treatment to be followed by prolonged immunity from disease." Cases may be observed, on the other hand, in which the tumour has no definite outline, being fixed to and incorporated with the neighbouring structures, so as to be absolutely immobile, being also of very rapid growth and accompanied by extreme emaciation. The function of the opposite kidney may be inadequate. Such cases are obviously unsuitable for surgical interference. "Before the operation every precaution should be taken against shock. Thus the limbs should previously be bandaged in cotton wool, the site of the wound only exposed, the head kept low, injections of pituitary extract should be ready, ether administered and warmth maintained during and after the operation. Finally, an assistant should always be at hand to perform saline infusion, and this, if used, should be resorted to before the close of the operation, when the condition of shock may be irremediable."¹ Blood transfusion may be useful before or after the operation.

During the operation itself the incision must be sufficiently free. The lumbar one, carried very freely forward² (p. 521), will give sufficient room for all except large tumours. The peritoneum will only be opened when the growth is large or adherent, when it is a great advantage to examine the peritoneal aspect and extent of the growth and secondary glands. Finally, as Mr. Malcolm has shown, every vestige of the capsule and all fat adjacent to it, together with any fat or glands about the renal vessels, should be removed.

The removal of renal growths through an anterior trans-peritoneal route used to be attended by about twice the mortality of the lumbar operation. This was chiefly due to greater risk of sepsis, but also to the fact that this method was used particularly for very large growths, considered to be too big to be removed through the loin.

In later cases, as shown by Heresco,³ there has been very little difference in the mortalities of the two methods.

Morris strongly advocated a combination of the lumbar and lateral trans-peritoneal methods for malignant tumours of the kidney. He first explored through the linea semilunaris and examined the connections of the tumour; then, after temporarily closing this incision, he enucleated the kidney through the usual incision in the loin. The original wound was then reopened and the peritoneum raised from the tumour, the pedicle secured and the growth pushed and delivered through the anterior incision.

He claimed that this method enables the surgeon thoroughly to explore the tumour and to determine the presence or absence of early secondary growths in the peritoneum and abdominal viscera before beginning the enucleation; also that the risk of injury of the great vessels

¹ Dr. Abbe strongly advises the use of the Trendelenburg position as emptying the blood from the growth into more important parts, and the injection of strong coffee and brandy into the rectum after the operation.

² Dr. Abbe used a similar one in his two successful cases mentioned above.

³ *Loc. cit.*

is less than if either an anterior or posterior incision is used alone, that the delivery of the tumour forwards is facilitated by a hand in the posterior wound. Moreover, the lumbar wound is the best for drainage.

(v) *Certain cases of injury* These are very rare, and fall into the following groups (a) Where an injured kidney protrudes from a wound of the abdomen usually the loin (b) In some cases of non penetrating wound of the kidney as when it is ruptured from a fall or blow (1) Where hæmaturia does not yield to treatment the bleeding being well marked or latent and insidious giving evidence indirectly of its existence by the increasing pallor the failing pulse impending syncope and perhaps a swelling in the loin (2) Later on when the injured kidney is setting up serious suppuration which does not yield to drainage (3) For ruptured ureter and traumatic hydro nephrosis.

At the present time if this condition be discovered at an exploration for traumatic hydro nephrosis it may be found possible to save the kidney by performing a plastic operation on the ureter. The author has successfully sutured the ureter in such a case. Tilden Brown however failed to discover a rent in the ureter until suppurative nephritis had developed and he was forced to remove the kidney about seven weeks after the injury.¹ When the ureter is accidentally divided during a pelvic operation if the calamity is discovered at once immediate anastomosis should be performed. If this fails and suppurative nephritis and a fistula follow then nephrectomy may become necessary.

(c) *Penetrating wounds* Very rarely indeed nephrectomy may be called for here (1) when hæmorrhage does not yield to treatment aided by exploration and plugging (2) when a urinary fistula persists after such a wound in certain cases e.g. when the other kidney is healthy (d) *Gunshot wounds* Whether in civil or military practice gunshot wounds of the kidney are only too likely to be complicated with injuries of the intestines liver and spine. When in the course of an exploratory operation in the case of a gunshot wound of the abdomen the kidney is found to be the seat of hæmorrhage if uncontrollable by other means nephrectomy should be performed.

(vi) *For a few rare diseases of the ureter* A very instructive case one of ureteral papillomata is described by Le Dentu and Albarran.²

Male 33 had had frequent attacks of renal colic for which nephrotomy had been performed without benefit. A diagnosis of ureteral papilloma was arrived at by means of the cystoscope. The kidney and ureter were therefore removed. The kidney was hydro nephrotic and the ureter contained two papillomata one three quarters of an inch below the renal pelvis the other at the vesical orifice.

(vii) *Hydatid disease of the kidney* Jerosch³ has recorded two cases of nephrectomy for this rare condition. In the first case death took place on the third day from exhaustion the second case recovered.

The results of nephrectomy for hydatid disease have been poor but in several instances this was due to excision of the only useful kidney⁴ a mistake which should be avoidable at the present day by adopting the methods of thorough examination advocated at p 514.

¹ *Ann of Surg* 1900 xli 127

² *Bull de l'Acad de Med* No 9 1899

³ *Centralbl f Chir* No 38 1899

⁴ Houzel quoted by Morris 1 681

Morris points out that the structure of the kidney may not be seriously affected by hydatid disease, and that nephrotomy is therefore more suitable than nephrectomy, which should only be adopted when there is "suppuration of the kidney, or rupture of the hydatid cyst into the lung or peritoneum." Secondary nephrectomy may be found to be required if nephrotomy and drainage, or excision of the cyst, fail to cure the disease.

The writer successfully removed a hydatid cyst, the size of a cricket ball, from the front of the right kidney of a boy aged 12. Before the operation the affected kidney was doing very little work owing to pressure upon the pelvis and ureter, but its function was restored by the operation.

(viii) *Cystic disease.* Surgical interference for polycystic disease of the kidney has been generally considered to be unwise, because of the frequency of bilateral disease and the belief that the second kidney may rapidly develop the same disease after the removal of the first. There are *exceptional cases*, however, in which nephrectomy is called for. These are cases in which the disease has been proved to be unilateral, and the symptoms are grave from rapid growth and increasing distension, and especially when repeated and profuse hæmaturia occurs.

Morris performed nephrectomy in four cases. Two of the patients were well three and seven years later, one died of similar disease in the other kidney four months later, and the other died on the second day from suffocation due to vomiting.

Morris¹ advocates his combined operation, with examination of the other kidney, by palpation, which he considers satisfactory in these cases, any enlargement being easily detected. When the condition is discovered for the first time during a lumbar exploration, the other kidney should be explored through the loin or through the anterior end of the wound already made,² before proceeding to excise the diseased kidney. This course may not be always necessary, for the cystoscope and estimation of the urea may have afforded ample evidence of the condition of the other kidney. It may be easy to tell that the kidney which is displayed in the wound is so diseased that it can take very little or no part in the excretion. In two cases known to the writer at Guy's Hospital it was considered to be unnecessary to explore the opposite kidney for these reasons. Both of them did well. The first had repeated and severe attacks of unilateral hæmaturia, which was thought to be due to malignant growth; the other was diagnosed as a tuberculous pyo-nephrosis. The temperature was intermittent and pain severe. Ten years later this patient returned with a large cystic kidney on the other side. The urine was albuminous and the patient suffering from chronic uræmia. It must not be forgotten that a large cystic kidney may not be palpable through the parietes. Dr. Bevan³ removed a large polycystic kidney which he discovered during an exploration for hæmaturia with severe pain on one side. The condition of the other kidney was not known, but the patient recovered and was well a year later. Dr. Parker Symms⁴ was unable to discover any enlargement of one kidney in a very thin woman with flaccid

¹ *Loc. supra cit.*, ii, 250.

² Barling, *loc. cit.*

³ *Ann. of Surg.*, 1904, xxxix, 467.

⁴ *Ibid.*, p. 598.

abdomen and he therefore judged that it was not enlarged therefore when the other kidney which was greatly enlarged was proved to be cystic on exploration it was removed. The patient was quite well a fortnight later. It is needless to say that the after history is too short. Dr Haynes¹ candidly reported the removal of one of two cystic kidneys the patient dying uræmic a fortnight later.

(ix) *Aneurysm of the renal artery*. This may be either traumatic or spontaneous. M. I. Conroy² estimated from post mortem records that only about 1 per cent of all aneurysms affect this artery. Sir Henry Morris³ in 1900 was able to collect the records of only 21 cases and two thirds of these were traumatic in origin. This collection included W. W. Keen's⁴ successful case. Conroy in 1923 succeeded in adding 11 cases but he overlooked three cases published by David Newman⁵ making 35 in all. Two of Newman's cases were very like the one recorded by the present writer⁶ for they were spontaneous in origin, saccular and situated within the kidney or its pelvis. One of these arose in the renal artery itself and the other like mine originated in one of the large branches of this artery. It is clear that this type is not easily recognised even when the kidney has been exposed in order to find and stop a painless hæmaturia which threatens life. It is probable that small aneurysms affecting the branches of the renal artery have been overlooked even after the kidney has been removed either during life or after death. It would have been easy to miss the small aneurysm which caused so much mischief in my patient.

Apart from hæmaturia these intrarenal aneurysms cause no symptoms or signs and are only found after death from some other disease. Traumatic aneurysms give rise to large swellings in the loin with signs of internal hæmorrhage.

Diagnosis. The diagnosis of spontaneous renal aneurysm depends chiefly on the great severity and recurrence of the painless hæmaturia, the absence of any history of injury and the absence of the shadow of a renal calculus. It is interesting that in several cases (including my own) the bleeding was so severe that blood ran continuously out of the urethra so that its source was at first thought to be uterine. Several cases have needed a catheter because clots blocked the urethra. Cystoscopy after washing out the bladder proves the absence of vesical growth and the issue of blood from one ureter indicates that the source is in the corresponding kidney. Newman in two cases noticed what he regards as a diagnostic sign, i.e. when interrupted pressure was made with the kidney between the hands—one behind and another in front—every time pressure was made a quantity of blood was seen to flow into the bladder and when the pressure was withdrawn the flow ceased. This is found in no other condition. This sign in his opinion should distinguish renal aneurysm from all other causes of severe hæmaturia.

In my case the blood escaped continuously and with great force during the cystoscopic examination. I have not noticed such forcible

¹ *Ann of Surg* 1904 xxx x 59

² *Ann of Surg* 1923 lxxviii 68

³ *Lancet* 1900 i 100 and *Surgical Diseases of the Kidney and Ureter* 1901 i, 238

⁴ *Phil Med Journ* May 5 1900

⁵ *Brit Journ Surg* 1915 ii 560

⁶ *Brit Med Journ* 1914 i 339

and profuse bleeding even with renal neoplasm, which, by the way, often forms a palpable renal tumour, which spontaneous aneurysm rarely does.

Treatment. Without operation the prognosis of bleeding renal aneurysm, either traumatic or spontaneous, is very grave. An early operation offers the only reasonable chance of recovery. Hitherto nephrectomy has been adopted in all but one of the successful cases. Orth,¹ operating for traumatic aneurysm, turned out the clots and successfully sutured the tear in the renal artery, but as a rule the condition of the kidney in these traumatic cases is so bad that nephrectomy is imperative. Before removing the kidney it is, of course, necessary to prove the presence and activity of the opposite one.

So far the diagnosis of spontaneous aneurysms in the kidney has been so uncertain and incomplete that in the few recorded cases nephrectomy has always been adopted, and on the whole very successfully. With the aid of a pedicle clamp, after delivering the kidney, incising the pelvis should enable us to make an accurate diagnosis of an aneurysm in a branch of the renal artery and to remove the aneurysm, which is usually quite small, without any loss of blood. It would be a great advance to save the kidney in this way, but it is probable that in some cases the aneurysm may not be discovered and possible that, in a few, another small aneurysm may be present in the kidney or subsequently develop in diseased arteries to give recurrence of bleeding.

Whatever operation is performed, these patients may be so ill and anæmic that blood transfusion may be necessary to give them a fair chance of recovery.

Operations. These are: A. Lumbar Nephrectomy. B. Anterior Extraperitoneal Nephrectomy. C. Transperitoneal Nephrectomy. D. The Combined Method.

A. Lumbar Nephrectomy.

Operation. The position of the patient and the earlier steps are much as those already given in the account of nephro-lithotomy, p. 521.

When the lumbar fascia has been slit up and the fat around the kidney incised, this organ should be well thrust up by an assistant making careful, steady pressure with his fist against the abdominal wall; the wound being now widely dilated with retractors, the surgeon examines the kidney, and has next to decide on three points: (1) Is removal required? ² (2) Will more room be wanted? If so, the incision already made, slightly oblique and about half an inch below the twelfth rib, should be continued downwards and forwards. (3) Is the kidney firmly matted down or no? If there has been no surrounding inflammation, the extra-peritoneal fat, the peritoneum and colon will be readily separated by the fingers working close to the kidney until the pelvis and vessels are reached. But if inflammation has caused firm adhesion and matting down of the kidney to adjacent parts, the altered fat and thickened and adherent capsule must be divided down to the kidney itself, and this gradually enucleated with the finger from within its capsule, which is left behind. This method of **intracapsular nephrectomy** is not

¹ Vide Conroy, *loc. supra cit.*

² This question has already been alluded to in the case of a tuberculous kidney incised and drained (p. 514); in that of a kidney much damaged by one or more calculi, under the subject of nephro-lithotomy (p. 530); and in the case of hydro-nephrosis (p. 539).

to be recommended unless it is absolutely necessary because disease may be left behind troublesome fistula may persist or a hæmatoma may form within the rigid walls of the cavity¹ Moreover it is very difficult to deal satisfactorily with the very short thick pedicle It is particularly unsuitable for tuberculous or malignant disease which call for removal of as much as possible of the fat and connective tissues around the kidney

The only guide in such a case is the tissue of the kidney itself close to which the finger must be kept

Mr Greig Smith stated² that in cases of old standing suppuration with great enlargement the vena cava and the aorta may be intimately adherent to the capsule One such case was met with in the post

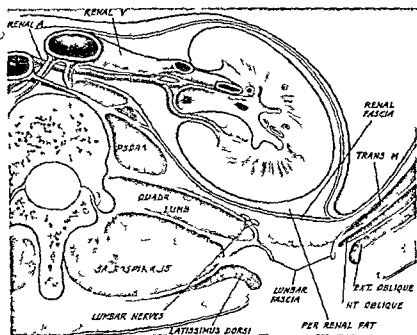


FIG 977 Section to show parts cut in lumbar nephrectomy

mortem room of the Bristol Infirmary here it was simply impossible after death to dissect apart the venous wall and the renal capsule In another case for similar reasons the organ could not have been removed by any proceeding claiming to be recognised as surgical

If further room is still required this may be easily and effectually gained by making use of additional incisions as recommended under Nephrolithotomy

Very large kidneys and renal tumours can be got out through very free lumbar incisions

In both Abbe's successful cases of sarcoma (*vide supra*) long transverse lumbar incisions were found to give ample room in the second case the tumour weighed 7½ lbs in a child only 14 months old

¹ Morris, *Lancet* January 1 1892

² *Abdom Surg* p 503

The danger of ventral hernia is guarded against by accurate sewing.

When the kidney has been sufficiently enucleated either out of its capsule or, together with this, out of the perirenal fat, the vessels and ureter must be dealt with. It is easier to deal with the vascular pedicle after the ureter has been isolated, tied and divided.

Whenever possible the vessels are carefully displayed and isolated by blunt dissection, clamped and tied separately with strong catgut. Two strong artery forceps grip each vessel in order, and a ligature is placed deep or proximal to the deeper forceps and tied as the latter is removed. Then another ligature is placed and tied close to the kidney, and the vessel is divided between this and the distal clamp, which is removed as the third ligature is tied in the groove left by it (*see* Fig. 285). If the kidney can be raised out of the wound, passing the ligature is much simplified. If this is impossible, the surgeon may find help by having the lower ribs well pulled up by an assistant, while another keeps the kidney well up, light being also thrown in, in case of need, by a forehead mirror or electric lamp.

When a pedicle presents especial difficulties from its shortness, thickness and the way in which it is overlapped by the kidney, two strong, safe pedicle clamps should be applied and the kidney removed by dividing the pedicle close to the kidney, a step which will give access to the vessels; a strong ligature is then tied in the groove left by the deeper clamp as it is removed; then another ligature is tied in the groove left by the other clamp.

Again, where the pedicle is very short, a small portion of kidney may be left to ensure the ligature retaining a safe hold.

A modification of the method of leaving a portion of the kidney to form the pedicle may be made use of in cases of kidneys of large size which cannot be brought through the wound. In such cases, the vessels having been secured by a temporary ligature or by forceps, the kidney should be cut away in separate portions, thus doing away with the struggle required to bring out a large kidney and the risks of tearing the vessels and of producing serious shock by pulling on the pedicle.

By such methods as the above the risk of wounding the cava or aorta is avoided. If the amount of kidney left is small, it will no doubt atrophy and give no further trouble, but if large, some sloughing will probably take place.

The question may arise as to what is to be done if hæmorrhage still persists after the kidney is got out and its pedicle tied. Very few cases will occur in which ligatures cannot be applied to each bleeding-point if the wound be well opened up, carefully dried, and if light be thrown down to the bottom. But when oozing still goes on, careful plugging must be resorted to; rolls of aseptic gauze are carefully packed into the bottom of the wound and around the pedicle. One end of each roll is secured to the lips of the wound. When the cavity has been tightly packed, an external gauze and wool dressing is applied and firmly bandaged.

When all bleeding is stopped, a large drainage-tube is inserted at the posterior angle of the wound, which is almost completely closed with catgut and salmon-gut sutures; aseptic dressings are applied.

If the ureter be dilated and contain pus or tubercular matter it should be tied with catgut and divided below the disease if possible if not the stump should be cauterised with strong carbolic acid or the actual cautery. Whenever possible the part of the ureter that is diseased should be removed with the kidney.

At the Mayo Clinic¹ it is not customary to remove the ureter but to be satisfied with ligation and cauterisation of the stump primary union of the wound resulting in nearly half the cases. Sir J Thomson Walker² defers ureterectomy for six months and then re-examines the patient in many cases he finds the operation is not required. H H Young³ also advises against primary complete ureterectomy believing that it is

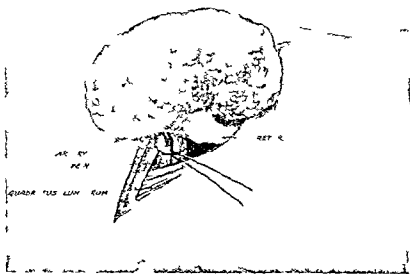


Fig. 8 Nephrectomy for tuberculosis of the kidney. The vessels are tied with strong suture. The diseased ureter also is removed.

safer to keep tuberculosis confined within the fibrous ureter where it can be treated if necessary later.

B Anterior Extraperitoneal Nephrectomy This allows direct peritoneal inspection with extraperitoneal enucleation. Sometimes it is desirable to avoid shifting to keep the patient on his back and to explore the abdomen to settle the diagnosis then I prefer a transverse incision extending forwards from below the end of the eleventh rib towards the umbilicus dividing the flat muscles of the abdominal wall but not more than one or two of the lower intercostal nerves (see Figs 279 to 283). The rectus muscle is drawn in or divided if necessary and the peritoneum is exposed and opened to allow the abdomen to be explored thoroughly and the opposite kidney felt. In this way the nature and source of a doubtful tumour or swelling can be immediately ascertained. Doubt may remain after the most careful preliminary investigations for instance the nature of a hydatid growing from the front of the right

¹ Collected Papers of the Mayo Clinic 193 xv 48

² Modern Op. Surgery i 60

³ Practice of Urology 1906 ii 784

kidney, was very uncertain until the peritoneum was opened by this transverse incision. The peritoneum was then closed and the cyst easily enucleated extraperitoneally without making an additional wound. A sarcoma growing from the meso-colon above the hepatic flexure was thought to be a renal tumour—a diagnosis which seemed to be confirmed by the small amount of urine issuing from the right ureter. A transverse incision opening the peritoneum revealed the real nature of the tumour, which had ruptured and was bleeding freely into the peritoneum; it was successfully removed.

C. Transperitoneal Nephrectomy. The transperitoneal operation is rarely indicated when there is a chance of septic or tuberculous infection

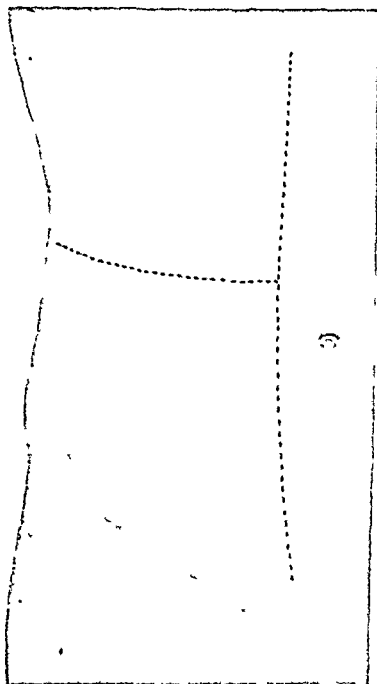


FIG. 279. Nephrectomy. Anterior incision. The horizontal part of the incision may suffice when the kidney is not very large. (After H. H. Young.)

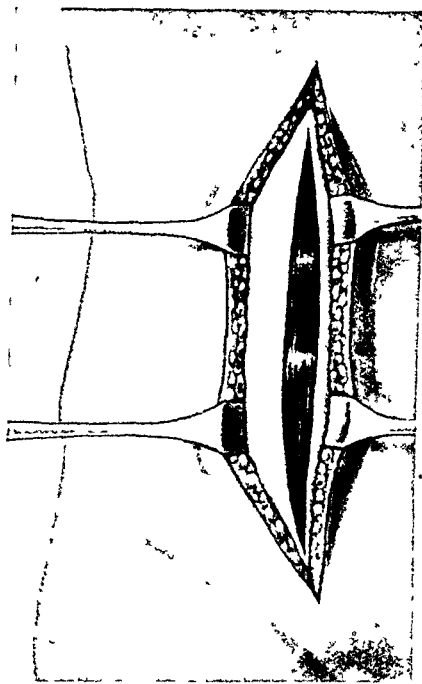


FIG. 280. Nephrectomy. Anterior incision. The rectus sheath has been opened. (After H. H. Young.)

from the kidney. For other cases, however, it is valuable, especially when thorough exploration of the abdomen and direct inspection of the front of the kidney are necessary before deciding upon nephrectomy. Therefore it is desirable when dealing with horse-shoe kidney, some complicated injuries of the kidneys and other abdominal viscera, and also for dealing with large cysts of uncertain origin. Above all, it is the operation of choice for malignant disease of the kidney, because it gives more room, allows more thorough exploration and the early ligation of the pedicle to prevent embolic infection: most important of all, it allow thorough removal of the peritoneum in front of the kidney and the fatty vascular and lymphatic tissues around the kidney and its pedicle.

It is to be hoped that this wide resection of renal growths will be,

followed by better results than those hitherto obtained by more limited operations

The patient lies in the dorsal position with the loin raised by the bridge or pneumatic cushion. The best incision is the T shaped one recommended by H. H. Young¹ in his admirable work. The horizontal limb of this incision is similar to the one described in the last operation. It stretches from just below the eleventh rib to a point 2 inches above and $\frac{1}{2}$ inch to the right of the umbilicus. The vertical limb extends from the right costal margin almost to the pubes.

We advise making only the horizontal part of the incision at first for

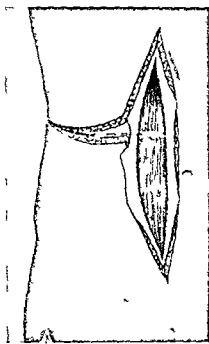


FIG. 28. Nephrectomy. Anterior T shaped incision. The muscles and the rectus sheath are divided along the dotted line. (After H. H. Young.)

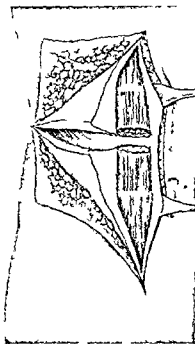


FIG. 28. Nephrectomy. Anterior T shaped incision. The rectus is divided at a tendinous intersection. (After H. H. Young.)

if the growth is irremovable this incision is sufficient for the exploration whereas if it is removable the vertical part can be added tentatively and lengthened as it may be required.

Once nephrectomy has been decided upon it is of great importance to allow plenty of room so that the tumour can be widely removed without undue handling which carries the risk of spreading the infection to distant parts. In the horizontal part of the incision the flat abdominal muscles are divided and the front wall of the rectus sheath. The rectus is drawn in or divided if necessary at the tendinous intersection found at this level. The vertical part of the incision opens the rectus sheath about $\frac{1}{2}$ inch from the middle line. The inner part of the sheath is

¹ *Practice of Urology* 1906 11-56

reflected inwards; the muscle is divided and turned outwards with the flat muscles. This incision, which divides no important nerves, compares very favourably with Langenbück's long incision along the outer border of the rectus. The abdomen and especially the liver are explored, and special attention is paid to the renal pedicle to ascertain if the disease is too extensive for removal; direct extension into the veins generally negatives resection.

Nephrectomy having been decided upon, the ascending or descending colon and other abdominal viscera are drawn in and carefully packed off. A long vertical incision is then made through the posterior parietal peritoneum, near the inner border of the kidney, care being taken not to injure

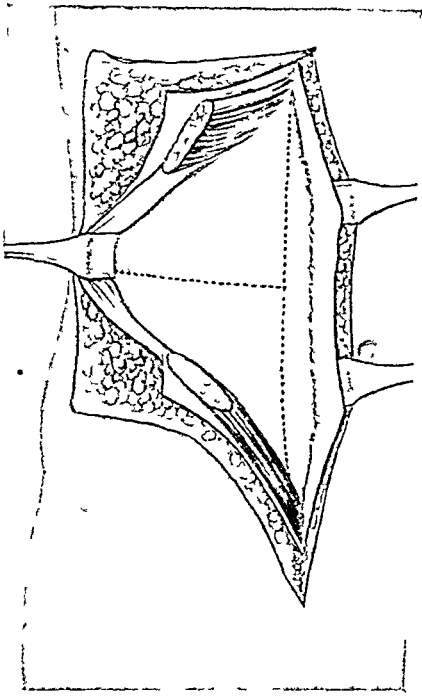


FIG. 283 Nephrectomy. Anterior incision. The rectus has been divided and reflected outwards. The peritoneum is opened along the dotted lines. No important nerves are divided. (After H. H. Young.)

the duodenum on the right side and the colon on both sides. The flap of peritoneum is turned inwards and the pedicle carefully examined, any fat or glands upon it being drawn outwards towards the kidney by blunt dissection, thus displaying the vessels and ureter. The latter is tied and divided well below the disease. The vessels are then clamped and tied individually or in small parcels, as already described under lumbar nephrectomy (p. 548).

If a portion of the growth extends along the renal vein into the vena cava a clamp may be placed, but not closed, upon the former near the vena cava, while a small incision is made into the vein and the growth is extracted with forceps. The clamp is then immediately closed, and the vein is tied. A wide circular incision is made through the peritoneum in front of the kidney, and the outer and upper borders of the latter are freed by blunt dissection, the surgeon

keeping as far away from the kidney as possible and tying off any vascular adhesions

As a rule it is necessary to remove the supra-renal gland after carefully tying its vessels. The kidney is thus removed with its peritoneal and fatty coverings complete. The posterior parietal peritoneum is mobilised and sutured with catgut after making a stab wound through into the loin at the outer border of the quadratus lumborum for the insertion of a tube. The packs are removed, and the abdominal wound is closed in layers, especial care being taken to get accurate approximation at the junction of the vertical and horizontal limbs of the T-shaped incision.

D. Morris' ¹ Combined Method has been described briefly at p. 542 ;

¹ *Surgical Diseases of the Kidney and Ureter*, 1901, ii, 250.



FIG. 94 Nephrectomy. Anterior exposure. The peritoneum is reflected to expose the renal vessels and ureter. (After H. H. Young.)

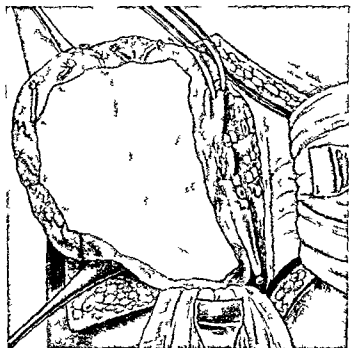


FIG. 95 Nephrectomy. The ureter and most of the vessels have been divided. The adherent peritoneum is removed with the kidney. (After H. H. Young.)

he recommends it for the removal of renal growths, but Young's method is more satisfactory, giving a better exposure and sounder abdominal wall.

Advantages of Lumbar Nephrectomy. It is certain that all kidneys of moderately large size can be easily removed by a lumbar incision sufficiently enlarged, and, in spite of all the improvements in abdominal surgery, the lumbar operation is the safest, especially when the kidney is



FIG 286. Transperitoneal nephrectomy for growth. The parietal peritoneum has been divided external to the colon and the latter has been drawn inwards with its vessels, to expose the pedicle of the kidney. The peritoneum in front, often adherent to the kidney, can be removed with the latter.

septic or tuberculous; it is also accompanied by less shock than the abdominal operation, although the latter method is strongly indicated for large renal growths, especially to give more room in children. Briefly, the advantages of the lumbar incision are: (1) The peritoneum, save in cases of exceptional difficulty, is not opened or contaminated. (2) Efficient drainage is easily provided. (3) The structures interfered with are much less important. (4) As pointed out by the late Mr. Greig Smith. "in the case of its being unwise, as in abscess, or in tumour affecting the surrounding tissues, to proceed to removal, it is less serious to the patient." (5) If the kidney is firmly matted down, as in the cases given at p. 516,

such dense posterior adhesions are most readily dealt with by the lumbar method (6) The lumbar incision if converted into a T shaped one or prolonged forwards, will give sufficient room for meeting most of the conditions which call for nephrectomy Thus modified, it will suffice for early new growths

Advantages of Abdominal Nephrectomy Opening the abdomen freely in front gives (1) Additional room in case of large kidneys (2) More easy access to the pedicle, the vessels of which can be tied early in the operation to lessen hæmorrhage during enucleation and perhaps to prevent embolic infection especially of malignant disease, this early ligation is however, not always possible for large growths may overlap the vessels, and in inflammatory cases there may be much confusion from matting and adhesions (3) The possibility of examining the condition of the other kidney, but this advantage is probably overrated, thorough examinations along the lines laid down at p 514 are far more reliable for a kidney which may seem to be normal to the touch may be insufficient after the other is excised (4) The extent, the presence or absence of secondary growth and the wisdom or otherwise of attempting nephrectomy can be decided early in the operation (5) The diagnosis can be made absolute between renal and other enlargements (6) The peritoneum in front of the kidney the infected perirenal fat and the lymphatic glands near the pedicle can be more freely removed

Disadvantages of Abdominal Nephrectomy (1) The peritoneal sac is opened (2) The same sac may be seriously contaminated if a kidney containing septic matter, or one largely converted into soft growth is ruptured during the needful manipulations (3) The intestines may be difficult to deal with, and may by crowding into the field of operation and the incision in the abdominal wall prove most embarrassing Peritoneal adhesions may follow and lead to intestinal obstruction later on (4) The handling and interference with the contents of the peritoneum may cause more shock (5) It is more difficult by this method, to deal with any dense adhesions which may exist behind the kidney (6) Efficient drainage is less easily provided in cases of any contamination of the peritoneal cavity or of oozing after the kidney is removed (7) The after complication of a ventral hernia is much more probable by this method though it must be allowed that the free lumbar incision already alluded to may be followed by the same result

Morris with all his experience,² advocated the use of the lumbar operation for all cases except for tumours injuries of the kidney which may be complicated by other injuries within the abdomen and the rare cases in which a kidney really floats in the peritoneal cavity anchored only by its pedicle, which is surrounded by peritoneum He stated that the lumbar operation ought not to be regarded merely as the operation of choice, with the exceptions stated, it is the only operation which ought to be considered justifiable The kidney as an extra peritoneal organ ought to be attacked from behind, and not across the peritoneal cavity

Causes of Death after Nephrectomy All these are now rare (1) *Shock* This may be induced by hæmorrhage, much traction on the pedicle and thus probably, interference with the solar plexus injury to the colon and, where the peritoneal sac is opened, by much disturbance

² *Loc cit*, ii, 239

of its contents. (2) *Hæmorrhage*. This is especially to be dreaded where the pedicle is deep and difficult to command; where there are aberrant renal vessels; where these vessels are enlarged and perhaps softened; where, owing to too much tension on the pedicle, a vessel retracts from within its loop of ligature; where the kidney capsule and tissue are broken into. In the intra-peritoneal method there is the additional danger of enlarged veins within the meso-colon. Secondary hæmorrhage has been alluded to above, pp. 531, 532. (3) *Uræmia and Anuria*. These are only likely to occur when it has been impossible to form a correct estimate of the condition of the opposite kidney, or where, to give a patient a chance, the surgeon operates in what he knows to be a doubtful case. Where there is reason to believe that the suppression of urine may be due to a calculus in the opposite kidney, this should at once be cut down upon in the hope of finding a calculus that can be removed. Mr. Lucas's brilliant example of what nephro-lithotomy may do, when such peril sets in at a later date, has been referred to at p. 535. (4) *Peritonitis*. While this is certainly more likely to follow the intra-peritoneal operation, it may occur after that through the loin, especially when much difficulty is met with here, owing to numerous adhesions or to working in a wound of insufficient size. (5) *Septic Trouble—Cellulitis—Pyæmia*. These are especially likely when the kidney contains septic matter, when the soft parts are much bruised. Other, rarer, causes of death are—(6) *Pulmonary Embolism*. (7) *Empyema*. This may be brought about by an extension of septic cellulitis, or by removing, during the operation, a portion of rib in order to get more room—a step the danger of which cannot be too strongly enforced (p. 523). An anatomical predisposition favouring the passage of inflammation from the kidney to the pleura has been pointed out by Dr. Lange, of New York. This authority on renal surgery found, in one subject, an enormous gap in the diaphragm, the muscle fibres being absent from the ligamentum arcuatum internum as far as the outermost part of the eleventh rib. Between these two points the fibres of the diaphragm communicated in a high arch, bounding an area in which the fatty tissue about the kidney was in direct contact with the pleura. (8) *Intestinal Obstruction*. This occurred fatally in one of Mr. Thornton's cases. He thought it was brought about by his suturing the two edges of the peritoneum over the kidney together, and thus producing kinking of the large intestine.

Partial Nephrectomy. This has been rendered justifiable by the results of experiments on animals. Morris¹ said: "Tuffier's experiments on animals, in 1888, and Barth's histological researches supply ample proofs of the healing power of the kidney, and the process by which healing is accomplished, even after extirpation of considerable portions. Paoli, of Perugia, performed extra-peritoneal operations for resection of the kidney upon twenty-five dogs, cats and rabbits, with perfect recovery."

Morris recorded ten cases of partial excision for disease—tuberculous foci, traumatic abscess, containing a secondary calculus, a cyst and a fistula—he has excised up to nearly one-half of the kidney for tubercle.

All the ten cases recovered from the operations, but one required total nephrectomy a week later for acute general pyelo-nephritis and died three months afterwards from general tuberculosis. Another needed

¹ *Loc. supra cit.*

nephro ureterectomy seven months later and in another symptoms returned within a year. The rest were well in 1900 except one who had died of acute broncho pneumonia three years after the operation.

Morris also gives a *resumé* of eleven operations (from foreign literature) three for cysts, three for calculous pyonephritis, two for new growths and one each for puerperal pyonephritis, renal fistula and a patch of interstitial nephritis mistaken for malignant disease.

None of these cases died, nine made good recoveries, one required nephrectomy and in one fistula resulted.

Ramsay¹ mentions nine cases of partial nephrectomy for tuberculous

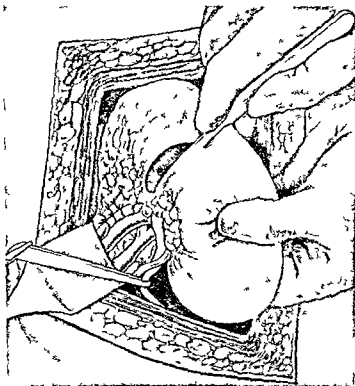


FIG. 297. Partial nephrectomy. (After H. H. Young.)

disease. In only two of these, however, was the result satisfactory. One reported by Israel was well one year later, the other by Morris was well two years later.

This operation may also be performed in cases of laceration of the kidney by injury where the greater part of the organ is uninjured. Here the organ will very likely be healthy and removal of an almost detached part may be sufficient to arrest the hæmorrhage. Mr. Keetley has recorded a case of this kind.²

A young man had been crushed by a waggon wheel. There was laceration. Five or six hours after the accident he showed signs of serious recurrent hæmorrhage.

¹ *Loc. supra cit.*

² *Lancet* 1890 i 134.

Through an incision a mass of blood-clot was scooped out, also the separated lower end of the kidney, a deep bleeding-point being compressed with sponges, which were removed in twelve hours. Convalescence was rapid. No urinary fistula or hydro-nephrosis resulted.

H. H. Young¹ has successfully resected the calculous half of a double kidney.

It may be said, therefore, that where, on examination of the kidney, a suitable opportunity presents itself, partial nephrectomy may be performed for any localised disease, such as large solitary cyst or abscess, and the greater part of the kidney saved in this way. The wound in the kidney may be sutured or the hæmorrhage may be arrested by

tying the entering vessels or by means of plugging with aseptic gauze, suturing being the preferable method where possible; for in this way both hæmorrhage and escape of urine will be prevented, and rapid healing of the whole wound thus secured.

In view of the unsatisfactory results, with a few exceptions, that have attended this method of treating tuberculous disease, and of the great difficulty there must be in making certain that all disease has been removed, it would seem wiser to remove the entire kidney in such cases if the opposite organ is known to be healthy.

Results. The late Sir. H. Morris² gave the following

statistics of his cases: (a) In twenty-nine nephrectomies for calculous disease there were five deaths; (b) in twenty-four nephrectomies for hydro- and pyonephrosis there were three deaths; (c) in twenty-two nephrectomies for tuberculosis there were five deaths; (d) in seventeen nephrectomies for tumour there were four deaths; (e) in three nephrectomies for fistula there were no deaths. Thus, there were seventeen deaths out of ninety-five cases.

The mortality has been greatly reduced in recent years: thus H. H. Young³ had only one operative death in 112 nephrectomies for tuberculous disease.

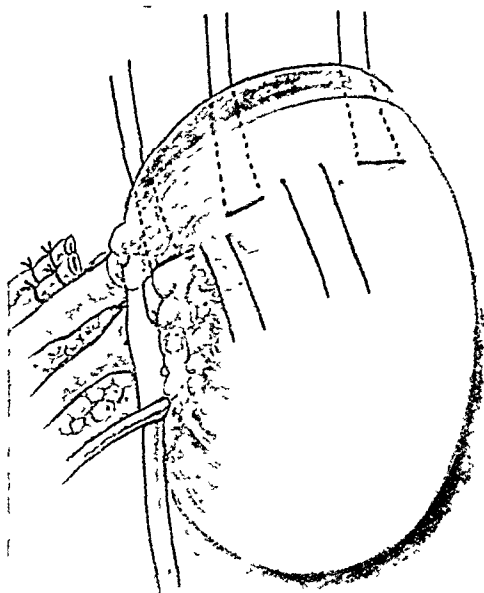


FIG. 288. Partial nephrectomy. The wound is closed by hæmostatic mattress sutures of stout catgut. (After H. H. Young.)

¹ *Practice of Urology*, 1926, ii, 272.

² *Surgical Diseases of the Kidney and Ureter*, 1901, ii, 275.

³ *Practice of Urology*, 1926, i, 324.

NEPHROPEXY

It is well known that nephropexy has not always been followed by the relief expected. This, I think, is due to one or more of the following causes

(1) The operation has been performed in unsuitable cases—therefore it has naturally fallen into disuse except for a few carefully selected cases. Care should be taken not to attribute to a movable kidney symptoms really due to other causes such as insanity, neurasthenia, dyspepsia, appendicitis or gall stones, for it is certain that many healthy women have freely movable kidneys. Larrabee¹ examined 272 women for movable kidney and found it in 112 or 41.5 per cent. in 39 it was merely palpable on deep inspiration, in 49 it could be kept down during expiration, in 24 it could be pushed about freely, in 10 cases there were no symptoms and in 66 some loss of weight. Only 6 patients gave a history of Dietl's crises.

Gordon² relates an interesting case in which a movable kidney was thought to be the cause of indigestion, constipation and attacks of pain in the right side. Nephropexy failed to give relief and later a simple stricture of the sigmoid flexure was discovered during an exploration for intestinal obstruction which proved fatal.

Again, where the mobility of the kidney is associated with a general proptosis of the viscera, especially of the liver, with long-standing dyspepsia or constipation or with uterine or ovarian trouble, it will be useless to perform nephropexy unless the other ailments can be corrected—a matter of no little doubt and difficulty in some of those patients in whom we meet with this disorder. In a certain proportion of movable kidneys—and this perhaps a larger one than is usually allowed—organic disease coexists as well. I have met with several cases of this kind. In one the kidney was the site of carcinoma; in a second early tubercular disease must have been present. About two months after the nephropexy pain having returned, further examination showed that the urine, which had before been found normal, contained pus. At a second operation two early foci of tubercular suppuration were found and the kidney was removed. Six years later the patient was alive and well. In several cases the mobility was associated with hydronephrosis. The question of nephropexy in hydronephrosis is referred to below. In many cases chronic appendicitis is the cause of pain erroneously referred to movable kidney. In others gall stones have caused the pain.

Mr F. E. Taylor³ records five cases in which unsuspected lesions were discovered during the operation of nephropexy. Three of these cases occurred in a series of thirty hospital patients. Renal calculi were discovered and removed in two cases and tuberculous disease in two others; in one of these partial nephrectomy of the lower pole was performed and in the other nephrectomy was necessary. The fifth case was one of hydronephrosis associated with movable kidney and probably due to the mobility.

Taylor concludes that an operation is indicated when some unusual

¹ *Boston Med. and Surg. Journ.* November 26, 1903.

² *Lancet* 1903, i, 1587.

³ *Ann. of Surg.* 1904, xl, 915.

or unexplained symptom is present, and still more if any tenderness or enlargement of the kidney can be made out." He also pleads for a more thorough examination of the kidney during the operation, and that the organ should always be brought outside the loin and carefully palpated and inspected and even incised if any doubtful spot is discovered.

(2) Another frequent cause of nephropexy failing to give permanent relief is the way in which the operation is performed.

In some cases—and this is very frequent—the kidney tissue itself is deeply traversed by the needle. Now, the friability of the kidney is well known. Every operator who has passed sutures in this way is familiar with their tendency to cut through before or just as they are finally tightened and tied. So soft is the tissue of the kidney, especially when injured and inflamed—as around a suture—that I believe, when unabsorbable sutures thus passed have been left *in situ*, their cutting through is only a matter of time and that catgut sutures unless well hardened are very soon absorbed.¹ Sometimes the kidney is fixed too low down, hydronephrosis or pyonephrosis resulting. Mr. Bruce Clarke² records an interesting case of this kind in which the kidney has been fixed so low that it nearly touched the crest of the ilium. Hydronephrosis developed and Mr. Bruce Clarke replaced the kidney after proving that there was no obstruction in the ureter. The kidney was regaining its normal secreting power and the patient was comfortable when last seen a few weeks after the operation.

Indications. To speak of the indications more exactly. Where an otherwise healthy kidney is very movable, especially where this dates in sensible people to an injury, if the surgeon is in doubt as to an operation, he should try to satisfy himself that other treatment, including a sufficient trial of a well-fitting apparatus,³ has failed, that the pain, whether constant or paroxysmal, is *bonâ fide*, and that it really cripples and spoils the patient's life. Constipation and dyspepsia will of course have been treated, tight lacing given up, and a trial made of a well-fitting truss or belt, or a corset coming low down in front and so fitted as to gather up the lower part of the abdomen and its contents. Thus, conditions of movable kidney which call for operation are :

(1) Frequent, severe and spasmodic attacks of pain, or more or less continuous suffering.⁴

(2) Dietl's "crises" consisting chiefly of violent attacks of colic, nausea and vomiting, tenderness and distension of the abdomen with collapse, and sometimes shivering and rise of temperature. These attacks

¹ Dr. Newman drew attention to this fact several years ago (*Lects. on the Surg. Dis. of the Kidney*, p. 69): "The sutures passed into the kidney became destroyed more rapidly than elsewhere; the living renal tissue seems to have an unusual power of absorption."

² *Lancet*, 1905, i, 8.

³ The best one that I know is the one recommended by Sir Frederick Treves (*Pract.*, January, 1095) and made by Ernst: "It consists of a thin, carefully-padded metal plate, which exercises pressure upon the abdominal wall by means of two springs. The pressure concerns the lower and inner margins of the plate, so that the kidney is forced upwards and outwards." Treves used the instrument for over 300 private patients, in 95 per cent. of whom "the truss proved absolutely efficient." "With the truss on the patient has been able to take active exercise, to ride, and in an occasional instance, to hunt." The instrument must be very carefully fitted, and must be applied when the patient is lying down.

⁴ Morris, *Surgical Diseases of the Kidney and Ureter*, 1901, ii, 221.

of them are not based on sound anatomical and mechanical principles, and others have been conceived in ignorance of Nature's ways of healing. No attempt will be made here to give an exhaustive account of all the ingenious devices that have been too often hastily recommended without allowing sufficient time to elapse for observation of the after-results: only a few typical methods will be briefly described. Operations based on fixing the fatty capsule only have been proved to be unsatisfactory. There is little doubt from experimental and clinical results that firmer union occurs when the cortex of the kidney is bared than when sutures which pierce the friable renal tissues are relied upon. Moreover such sutures are not quite devoid of danger, as already pointed out, and there are cases on record in which these sutures have caused urinary fistulæ due to laceration of the kidney. It is true that the leakage was not permanent, but it was troublesome and avoidable; in one case a second operation was required.¹ It is safer and better to pass the sutures through the capsule only, unless the latter is too thin to be relied upon. In my opinion the usual oblique lumbar incision gives more room and far better access to the kidney and allows a more thorough examination of the pelvis and ureter than the vertical incision advocated by some surgeons, and my experience of the prone position has not impressed me favourably, for it certainly embarrasses the breathing and increases venous congestion and bleeding. All attempts to fix the kidney through the peritoneal cavity are to be condemned as futile and unnecessary. Passing stitches through the pleura and diaphragm to endeavour to fix the upper end of the kidney is not to be recommended, because it is at least meddlesome and it is enough to secure the lower two-thirds of the organ. As regards the parietes, the kidney and its fibrous capsule should come into contact with the raw surfaces of the quadratus lumborum muscle and the deeper part of the parietal wound; but the kidney must not be drawn too much into the wound, where it will be exposed to injuries and especially liable to nephritis, soon after the operation, as shown by Wolff.² Fixation of the lower end of the kidney only, in the attempt to get it into a high position, may lead to anteversion of the organ or to stretching of the adhesions, due to the pressure of the diaphragm and liver on the upper pole. On the other hand, fixation at too low a level may lead to kinking of the ureter and to hydronephrosis, and perhaps to pain from the pressure of the corset at the waist.

For the average operator and an average patient it must be unwise to attempt to fix both kidneys at the same time, although Edebohls, with his great experience, did not find this practice dangerous. In more than a third of his cases the double operation was performed.

Operation. The kidney is first thoroughly exposed by the steps given at p. 521, an assistant keeping the organ well pushed up into the loin while the surgeon cuts down on it. I may here say that in some of these cases of very movable kidney the tissues around are so loose from the dragging and shifting to and fro of the kidney that they wrap round the organ very closely, and thus it is easy to injure the peritoneum, unless care is taken to open the fatty capsule only at the upper and inner end of

¹ Clayton Greene, *Lancet*, 1904, ii, 1711.

² *Deutsche Zeitschrift für Chirurgie*, Leipzig, 1897, xlvii, 533.

the wound Any excess of perirenal fat is removed, so that the muscles are bared

The kidney itself having been exposed it is gently withdrawn through the wound and thoroughly examined for signs of disease, the pelvis and the upper part of the ureter are examined for dilatation abnormal renal vessels, kinking, stricture and stone Then an incision is made with a very light hand all along the convex border from end to end Unless the utmost gentleness is taken in the last step the tissue of the organ itself will certainly be incised, causing free oozing With the handle of a scalpel or a blunt dissector, flaps of capsule are then deliberately but gently stripped off the kidney up to a point about halfway along its surfaces so as to raise sufficient flaps for the sutures to find a holding in The flaps having been raised, they are sutured with medium sized sterilised catgut to the aponeurotic and muscular edges of the wound To get a firm and permanent holding each suture should take up plenty of capsule on the one side and a sufficient grip of the lumbar fascia on the other I generally use six sutures three on each side One word of caution should be added This method of anchoring is so efficient that unless care is taken it is possible to fix the kidney which has been drawn out actually between and not beneath the lips of the wound After one row of sutures, say the upper has been inserted tied and cut short and the second merely inserted care should be taken to push the kidney gently into its proper place in the loin just under the wound and to see that the ureter is not kinked, the lower sutures are then also tied cut short and dropped in Any oozing met with after stripping off the flaps of capsule will yield to firm sponge pressure kept up by an assistant while the surgeon is putting in his sutures If when all bleeding is arrested the wound is very carefully dried out no drainage tube will be required The muscles and fascia are joined accurately with two continuous catgut sutures and the skin with fine linen thread This method is both easy and efficient Newman¹ employs a very similar one and speaks well of the results He inserts a large drainage tube between the kidney and the deeper parts of the wound in order to promote adhesions to the wound

Edebohls' Operation The patient is placed in the prone position with an air cushion (fourteen inches long and eight inches in diameter) supporting the abdomen and pushing the kidneys well back into the loin Edebohls maintains that this position does not embarrass the breathing or render anaesthesia difficult or dangerous it greatly facilitates the finding and delivery of the kidney

A vertical incision is made along the outer border of the erector spinae from the last rib to the iliac crest, the fibres of the latissimus dorsi are separated and the lumbar fascia is incised so as to expose the perirenal fat, and sometimes the ilio hypogastric nerve, which may be drawn aside or divided and reunited later on

The anterior lamella of the lumbar fascia is slit vertically and retracted in order to expose freely the muscular fibres of the quadratus lumborum which are destined to form an adhesive bed for the kidney

The kidney is sought and freed by the fingers, and together with its

¹ *Surgical Studies Renal case*

² *Ann of Surg* 1902 xxxv, 174

fatty capsule it is brought out on to the loin : if the incision is too small to allow this, more room may be obtained by incising the outer fibres of the quadratus near the ilium. The fatty capsule is removed, and the

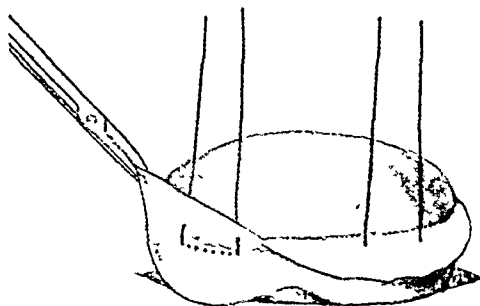


FIG. 289. Nephropexy (After Edebohls.) The suspension sutures placed in the fibrous capsule.

kidney, pelvis and upper part of the ureter are thoroughly palpated and inspected or even incised if necessary. The fibrous capsule is nicked at the middle of the convex border and slit from pole to pole along a grooved

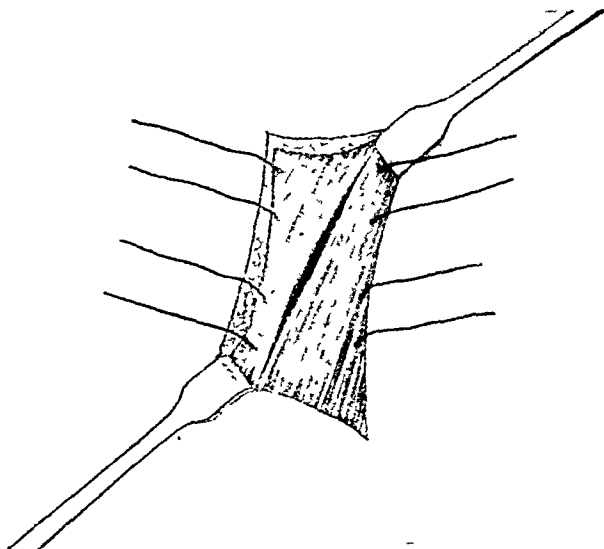


FIG. 290. Nephropexy. (After Edebohls.) The suspension sutures piercing the muscles. the fibres of the latissimus dorsi have been separated only.

director. Anterior and posterior flaps are raised by blunt dissectors, so as to denude the outer half of the cortex : some of the flaps may be removed if they are too large.

"Four suspension or fixation sutures of forty-day catgut" are passed through the fibrous capsule, two to each flap, as shown in Fig. 289. Each

suture pierces the flap near its base and also the attached capsule under which it runs for a distance of two to three centimetres, a Hagedorn needle held on the flat is used to pass the suture to avoid penetration of the cortex of the kidney.

When all the sutures have been placed the kidney is returned into position, and the anterior and posterior sets of stitches are passed through the parietes at a distance of about an inch and a half from each other. The inner sutures pierce the anterior lamella of the lumbar fascia, the quadratus lumborum, the erector spinæ and the latissimus dorsi, the outer ones pass through the lumbar fascia and the latissimus dorsi. The highest stitches are close to the last rib. The parietal wound is closed with catgut sutures "passed in such a manner as to turn the raw surface of the quadratus towards the kidney," and lastly the suspension

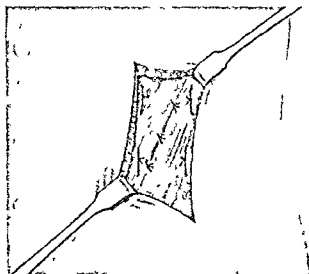


FIG. 291. Nephropexy, sutures tied. (After Edebohl.)

sutures are tied as shown in Figs. 290 and 291. The wound is not drained but is completely closed by means of the intracuticular suture.

Edebohl does not claim that the kidney is fixed as high as the normal position, but that it is placed high enough for practical purposes. Moreover, he maintains that it is not wise to attempt high fixation, lest the liver in descending lengthen the adhesions or cause anteversion of a kidney which has only been fixed at its lower part, which is common when high fixation is attempted.

So certain is he that other diseases frequently coexist with movable kidney, that he often opens the peritoneum to the outer side of the kidney and explores the gall bladder and ducts, the duodenum and pylorus, and especially the appendix, which he often removes through the loin. He then closes the peritoneum and proceeds with the nephropexy.

The Mortality of Nephropexy. Morris¹ reports 80 operations without a death, and Tuffier 75 with 2 deaths.

¹ Morris, *loc. cit.*, p. 236.

Goelet records 171 operations on 134 patients without a death.¹

Edebohls has also operated on 135 successive cases without a death, and he quotes Johnston as having operated 107 times without a fatality. It may be stated that at the present time the mortality should not be more than 1 per cent.

Deaths have occurred from sepsis, peritonitis, tetanus, pulmonary embolism, broncho-pneumonia, uncontrollable vomiting. Pulmonary embolism is a common cause of death and is probably due to thrombosis of the renal vein, which may occur when the kidney has not been pierced by any suture; it may be due to laceration of the lining of the vein during forcible attempts to deliver the kidney combined with the enforced rest that must follow the operation.

Accidents that may happen during the operation. Laceration of the kidney may occur during its delivery, but it is more common as the result of tension on sutures which pierce the kidney. Edebohls² reports a case in which a fistula persisted for three and a half months, and he refers to three other cases.

Clayton Greene³ reported an interesting case, which is probably unique. A fistula followed the use of deeply penetrating catgut sutures. It closed after the removal of some deep sutures, but six months later another operation was required for pain and swelling. A clear fluid, presumed to be urine, was found within a greatly thickened true capsule, which was detached from the kidney, except at the hilum.

The peritoneum may be opened, because the liver may be mistaken for the kidney. The colon may be wounded, and the pleura has been opened, causing temporary pneumothorax. The ureter has been torn.

Results. It is to be regretted that some of the energy devoted to inventing and publishing new methods is not spent on following cases and recording ultimate results.

Very few statistics are of any great value, because the patients have not been examined after a sufficient length of time; it is absurd to claim cures after a few months only, for it is well known that fibrous adhesions often stretch, and even vanish in time.

In 1898, Edebohls⁴ personally examined 55 of his patients who had been operated upon from one to eight years previously. In 50 the kidney was firmly fixed; in 5 the adhesions had stretched more or less, but none of the kidneys could be pushed up under cover of the ribs, as in an ordinary movable kidney. Edebohls therefore asserts that they are not detached. One seemed to be movable enough to require a second operation, which showed that the kidney was fixed, and could not be detached without tearing the renal tissues.

The results must be judged by a more important test than that of mobility; it is far more essential to know if the patient has or has not obtained relief from her symptoms. The relief of symptoms will generally prove both the accuracy of the diagnosis and the efficiency of the treatment. It is poor consolation to know that a kidney has been fixed when symptoms supposed to have been due to its mobility still persist.

¹ *Ann. of Surg.*, 1903, xxxviii, 769.

² *Ann. of Surg.*, 1902, xxxv, 157.

³ *Lancet*, 1904, ii, 1711.

⁴ *Loc. supra cit.*

On the other hand it matters little if a kidney become slightly too movable if the patient does not suffer from it. It is to be hoped that more prominence may be given to these points in future statistics.

THE SURGICAL TREATMENT OF NEPHRITIS

The late Mr Reginald Harrison¹ was the first to advocate surgical treatment for nephritis. He suggested that the improvement which may follow chance operations upon kidneys which are in a state of chronic nephritis might be due to the relief of tension within the capsule of the kidney. Harrison therefore practised and recommended renipuncture for Bright's disease. Later he performed capsulotomy and nephrotomy.

Israel in 1899 drew attention to the disappearance of symptoms of renal disease after negative explorations for stone, but he did not recommend surgical interference for Bright's disease.² Ferguson, Edebohl, and Pousson in 1899 advocated surgical intervention in certain cases of nephritis including chronic Bright's disease.

In view of the grave prognosis of this disease under medical treatment it is certainly worth while to consider the advisability or otherwise of seeking aid from surgery, but it remains to be proved that operations are either hopeful or even justifiable in any cases of genuine Bright's disease.

Two operations require consideration. (1) Harrison's operation.³

The fibrous capsule is exposed and incised along the convex border for a distance of about two or three inches. In some cases Harrison punctured the kidney in various directions, avoiding the pelvis; in others he incised the cortex more or less freely.

The Indications for the operation as given by Harrison at the International Congress at Lisbon, 1906,⁴ are as follows:

(1) Progressive signs of kidney deterioration as shown by the persistence of increase of albumen when it should be disappearing from the urine as in the natural course of inflammatory disorders ending in resolution.

(2) Actual or threatened suppression of urine.

(3) Where marked disturbance of the heart and circulatory system occurs in the course of inflammatory renal disorders.

A consideration of the pathology of Bright's disease, of the experimental evidence and of the theory of renal tension does not commend this operation to me. It is almost certain that any relief that may be derived from the operation may be obtained with far less risk by medical treatment.

The following remarks made by Sir Henry Morris after a vast experience of diseases of the kidney show how dangerous operations may be in Bright's disease. Surgical operations and more especially operations upon the urinary organs if it be possible to postpone them should never be undertaken during the existence of acute or subacute interstitial nephritis or any form of congestive urinary fever.⁵ When a series

¹ *Brit. Med. Journ.* 1896: 1195.

² *La S. m. Méd.* February 5, 1904.

³ *Lancet* 1901: 330.

⁴ *Ibid.* 1906: 150.

⁵ *Surgical Diseases of the Kidney and Uret.* 1901: 316.

of consecutive cases treated by operation is published and the results are found to compare favourably with these obtained by less heroic measures, physicians may no longer shrink from submitting their patients to operation, but until then discretion is certainly the best part of valour.

(2) **Renal Decapsulation.** Edebohls "originally devised, proposed and performed" this operation for the treatment of chronic Bright's disease.¹ He exposed the kidney through the vertical incision, which has already been described under nephropexy at p. 563, and the patient is placed in the prone position with an air cushion supporting the abdomen. Both kidneys are therefore accessible without changing the patient's position. The following description is taken from Dr. Edebohls' paper in the *Brit. Med. Journ.*, 1902, ii, 1507: "If possible, next deliver the kidney into the wound or out upon the skin of the back, a procedure which greatly facilitates further operative procedures in both renal decapsulation and nephrotomy. When such delivery of the kidney is impossible, the rest of the work must be done at a great disadvantage with the kidney well up underneath the lower ribs and with the fatty capsule constantly overlapping the organ to a greater or less extent." By adopting the usual oblique incision it is much easier to bring the kidney into the wound, especially in men and in patients with a small interval between the last rib and the iliac crest, and the risk of hernia is very small if the muscles are sutured carefully.

"In performing renal decapsulation the operator next proceeds to separate bluntly the fatty capsule from the capsule proper, the dissection being continued on either aspect and around both poles of the kidney until the renal pelvis is reached. Now and then the fatty capsule may be found so thickened and adherent, as the result of chronic perinephritis, that the scissors or knife may be required to separate it from the capsule proper. The kidney with its capsule proper is next lifted from its fatty capsule bed, and if possible delivered into or through the wound. The capsule proper is divided on a director along the entire length of the convex external border of the kidney and clear round the extremity of either pole. Each half of the capsule proper is in turn stripped from the kidney and reflected toward the pelvis until the entire surface of the kidney lies raw and denuded before the operator. In separating the capsule proper from the kidney care must be taken not to break or tear away parts of the kidney substance, which is often very friable and very firmly connected with the capsule proper, especially in the presence of chronic interstitial nephritis. I have found the smooth surface of the index finger of the rubber-gloved hand the best instrument for safely effecting separation of the capsule proper from the kidney. The stripped-off capsule is next cut away entirely, close to its junction with the pelvis of the kidney, and removed. Delivery of the kidney into the bottom of or out of the wound greatly facilitates the decapsulation part of the operation."

The kidney is dropped back and the wound closed without drainage except under exceptional circumstances. Both kidneys are operated upon at one sitting so as to avoid the dangers of two anaesthetics, which is important in these cases of nephritis. "Decapsulation of both kidneys for chronic Bright's disease requires for its performance from half an

¹ *Med. Rec.*, December 21, 1901, pp. 961-970, and *Med. News*, April 22, 1899.

hour to one hour from first incision to complete closure of both wounds and the application of dressings Decapsulation of one kidney is in itself, less serious than either nephropexy nephrotomy resection of the kidney or nephrectomy "

Edebohls performed his operation not only for cases of Bright's disease but also for acute pyelo nephritis with miliary abscesses hydro nephrosis pyonephrosis polycystic kidney and puerperal eclampsia ¹

From observations which were made during three secondary explorations upon kidneys which had previously been fixed Edebohls concludes that decapsulation allows anastomoses to occur between the vessels of the perinephritic tissues and those of the kidney and that this may provide an additional blood supply to the organ An increase of blood supply may lead to absorption of the inflammatory products and to the removal of pressure upon the tubules and glomeruli which may then resume their normal function It is not claimed that improvement is rapid but that it is progressive albumen only disappearing after from one to twelve months

Edebohls ² had operated upon 72 patients up to the end of 1903 Of these 4¹ survived and had been traced for periods varying from 6 months to 17 years 19 of them suffered from chronic diffuse nephritis 17 from chronic interstitial nephritis 7 from chronic parenchymatous nephritis and 4 had chronic interstitial nephritis of one kidney and chronic diffuse inflammation of the other Twenty one of the patients were cured and only six were not improved to some extent, the greatest improvement occurring in the cases of chronic interstitial nephritis and the least in the chronic diffuse nephritis

Whether decapsulation will ever become a recognised method of treatment of intractable cases of chronic Bright's disease is uncertain So far it has not found favour with English surgeons and physicians

Theoretically there is little to recommend it for a free vascular anastomosis can hardly be expected to form between the kidney and the anæmic fatty capsule which surrounds it The tension within the fibrous capsule cannot be high for any length of time for the capsule is thin and delicate in cases of chronic nephritis and it is quite capable of stretching as is shown by the rapid enlargement of the kidney which occurs in acute nephritis and in some cases of hydro-nephrosis Moreover the kidneys of chronic interstitial nephritis are usually smaller than normal and still it is in these cases that decapsulation is claimed to do most good It would be far more reasonable to take away or incise the dense and thick tunica albuginea from an inflamed testicle for the relief of tension than it is to remove the thin capsule which invests a shrunken and chronically inflamed kidney In acute nephritis incision of the capsule might really be expected to relieve tension but decapsulation has not been at all successful in these cases, although a few recoveries have followed operation for actual or threatened suppression of urine in scarlatinal nephritis These results were not necessarily due to the interference but may have occurred in spite of it

Is it to be expected that decapsulation may arrest a renal degeneration and vascular sclerosis, that have gradually increased for years in the majority of the subjects of chronic Bright's disease ?

¹ Two successful cases (*Boston Med and Surg Journ* June 2, 1904)

² *New York Med Journ* May 21 1904

Experimental evidence lends but little if any support to the advocates of this operation, and it fails to demonstrate any real anatomical reason for its supposed success. The literature of the subject is full of vagueness, inaccuracy and confusion. Cases of movable kidney, with or without nephrectasis, have been frequently classified as instances of Bright's disease, and even cases of ascending nephritis have been included. No one denies that decapsulation and fixation of a movable kidney may do good, and that the hydro-nephrosis and transient albuminuria which may be secondary to it may be cured by nephropexy.

Newman drew attention to this fact many years ago.¹ These cases should not be confused and classed with those of the bilateral and far more serious disease which was described by Bright.

Many writers seem to forget that patients not uncommonly recover from Bright's disease without operation, and particularly that spontaneous improvement may occur and last for a long time, only to be followed by relapse after months or years. Recorded cases, with few exceptions, have not been followed up for a sufficient length of time to justify their classification as cures. It may be seriously doubted whether the results in patients who survive the operation are any better than those obtained in the same time and with far less risk by medical treatment. Suppuration is apt to occur in the wound even when every care is taken to avoid sepsis, and Edebohls lays stress on the dangers of the anæsthetic in these patients.

The operation is very dangerous in acute nephritis, and it should not be undertaken in patients with cardiac dilatation and anasarca. Albuminuric retinitis is an absolute contra-indication.

It may be stated in conclusion that published facts do not lead us to hope for favourable results from surgical interference in Bright's disease. In suppression and perhaps in grave cases of eclampsia, an operation may not be more dangerous than leaving well alone, and time and experience may prove that incision of the renal capsule may give relief. In some cases of chronic interstitial and chronic parenchymatous nephritis, which have been medically treated without avail, the patients should be given the opportunity of declining or accepting an operation which may offer a faint hope of relief; but all the dangers and chances of the operation should be explained to the patients and their relations. This operation is still performed in selected cases, and some successes are claimed.²

OPERATIONS ON THE URETER

There are two main conditions in which operations on the ureter are necessary :

A. Ureteral Obstruction.

B. Injuries to the Ureter.

A. Ureteral Obstruction. This in the great majority of cases is due to the impaction of a calculus in the ureter; in others, however, it has been found to be due to a valvular formation at the opening of the ureter into the renal pelvis or to a stricture of the ureter. These conditions will be considered separately.

¹ *Lancet*, January, 1886, p. 160.

² *Med. Annual*, 1923, p. 312.

I URETERAL CALCULUS There can be no doubt whatever that in many cases, where a renal calculus has been diagnosed and none found, the stone has really been in the ureter

Morris¹ during his first twenty years' experience of renal surgery "had six cases in which a stone must have been present in the ureter at the time of the operation although the kidney was explored with a negative result in each case" Five of these patients subsequently passed a calculus, and the other one died about a year later and a stone was found near the lower end of the ureter Other surgeons have had the same experience, but in many cases the stone has been found in the ureter near the kidney At the present day there is less excuse for this error, which was unavoidable in the past, for the perfection of systematic examinations of all the urinary organs especially by radiography and cystoscopy with ureteral catheterisation has provided the surgeon with means of almost accurately localising most calculi before an operation is undertaken for their discovery and removal

Whenever possible, such examinations should precede all explorations of the kidney and ureter They enable the surgeon to reach the calculus by the most suitable route, with the least possible amount of injury to the patient, and also to avoid many an unnecessary exploration on the one hand or an incomplete operation on the other

It should not be forgotten that small calculi especially if they consist chiefly of uric acid, in stout patients may not show on the radiogram, and yet that these may be large enough to produce a fatal anuria In rare cases, other things such as blood inspissated pus or hydatid cysts, may do the same Moreover, a positive X ray result may mislead, cretaceous mesenteric glands, atheromatous patches in the arteries, phleboliths or calcifying centres in the pelvic ligaments may occasionally lead to error Such mistakes may be avoided by cystoscopy with ureteral catheterisation, and a careful study of the clinical symptoms and signs Leonard,² however, in 330 radiographic examinations for renal and ureteral calculi found the negative and positive errors to amount to less than 3 per cent The writer has removed many ureteral stones which radiography had failed to show Cystoscopic examination after injection of indigo carmine is invaluable in these cases, for little or no pigment issues from the obstructed ureter The ureteral orifice often shows congestion, œdema, prolapse or even a projecting portion of the calculus

Abdominal and vaginal or rectal palpation of the ureter also should be practised more frequently for diagnostic and localising purposes A prolapsed ovary has been mistaken for a calculus, however, but this mistake may be avoided by remembering that a calculus in the lower ureter will be placed nearer the surface and antero externally to the vagina, whereas a prolapsed ovary is softer and placed behind the vagina³

During operation upon the kidney and ureter, when there is any suspicion of the existence of a calculus or of any obstruction in the course of the ureter, it is always wise, if not imperative, to pass a ureteral catheter, bougie or sound into the bladder, and also up into the pelvis of the kidney if the ureter only is exposed The surgeon may thus

¹ *Surgical Diseases of the Kidney and Ureter*, 1901, ii, 443

² *Lancet*, June 17, 1905

³ Cullingworth, quoted by Morris *loc cit*

discover a second stone or some other obstruction which might be otherwise easily overlooked and render the operation incomplete or useless, whether the X-rays have been used or not.

Site of Impaction. Impaction of a calculus may take place at almost any point in the course of the ureter, although in most cases it occurs at or near one of the three following narrow places :

(a) About two and a half inches below the hilum of the kidney or about an inch below the junction of the renal pelvis and the ureter ; here the diameter is about one-seventh of an inch.¹

(b) Near the pelvic brim ; here the diameter is about a quarter of an inch.

(c) At or near the vesical orifice ; at the orifice the diameter is only one-tenth of an inch.

Tenny ² found that 35 stones were arrested at the upper constriction, 18 only at the middle and 73 at the lower one. Bovée ³ records 22, 17 and 18 at these sites respectively.

It may be confidently stated that about 70 per cent. of ureteral stones are arrested at or near the lower constriction in the pelvis, and that many more will be found at the upper constriction than near the pelvic brim.

A calculus placed within the renal pelvis, acting as a ball valve, may obstruct the orifice of the ureter and even cause fatal anuria ; but it must not be regarded as a "ureteral" calculus in the sense which is attributed to this word here.

Indications for Operation. (a) When the ureter of the only active kidney is obstructed and anuria exists, an immediate operation is imperative (*see p. 532*).

(b) When only one ureter is obstructed, there is not the same urgent need for treatment, for it is a matter of common experience that many ureteral calculi are passed naturally. Leonard ⁴ states that 26 of his 40 patients passed the stones which had been demonstrated by the X-rays. If a calculus is known to be small from an examination with the screen, especially if it is shown to have descended between two examinations, and colic, but no complications, exist, expectant treatment may be tried, as recommended by Leonard. Large quantities of any alkaline mineral water and diuretics may be given with the idea of increasing the volume and pressure of the urine, and urotropin or helmitol may be given with the object of keeping the urine aseptic. Ureteral bougies and lubricants, such as liquid paraffin, injected into the ureter often help. Sometimes incision of the ureteral orifice through the operating cystoscope liberates a calculus impacted at this opening. It is known that the kidney may resume its normal function after being obstructed more or less completely for weeks.

Immediate operation is demanded when :

(a) Another calculus, which is too large to travel along the ureter, is detected in either kidney, or in the other ureter.

(b) When the calculus in the ureter is large and is really impacted and not merely passing down the duct. When the obstruction is com-

¹ Deaver, *Ann. of Surg.*, 1906, i, 733.

² *Bost. Med. and Surg. Journ.*, February 4, 1904.

³ *Washington Med. Annals*, 1905, iv, 233.

⁴ *Loc. cit.*

plete or nearly complete as shown by the small volume of the urine and by cystoscopic examination operation should not be delayed lest the kidney be irreparably damaged

(c) When there is evidence of any septic complication or of nephrectasis as shown by fever pyuria and enlargement of the kidney or great tenderness in the region of the calculus The writer removed a calculus in such a case—a very stout woman—after impaction for seven weeks Although the kidney was in a state of ascending suppurative nephritis with nodular enlargements it completely recovered in a few weeks Eight years later a calculus impacted in the opposite ureter was removed on the third day and the patient was well in three weeks a great contrast to the severe and prolonged illness which was due to delay before the first operation

Operation (1) *Impaction of a Calculus at or above the Brim of the Pelvis* In these cases the ureter can be sufficiently exposed by prolonging the incision already made for exploring the kidney as above described (see p 521)

In some cases the dilatation of the ureter above the site of impaction will allow the calculus to be pushed up the ureter to some more accessible part

If the stone cannot be pushed up as far as the kidney or is so tightly impacted that it cannot be moved it should be removed through a longitudinal incision in the ureter The incision in the ureter may be sutured with fine catgut passing through the outer coats or it may be left without sutures Should inflammatory thickening or ulceration of the ureter be present it would seem wiser not to insert any When a stricture is found it is overcome by a plastic operation

When it has not been possible to locate the calculus before the operation experience shows that the lumbar incision is the best to adopt In 28 out of 41 cases recorded by Henry Morris this incision was used under the impression that the disease was renal and in 25 of these cases the calculus was accessible There is therefore a fair chance of finding the calculus and also of removing it through this incision

Moreover the kidney can be examined or removed if necessary granted that the other kidney is known to be healthy In three of the 25 cases quoted by Morris nephrectomy was adopted In any case a fistula can be established and the kidney given a chance to recover

If the stone cannot be found in the upper ureter it should be sought with the ureteral sound passed through an incision in the renal pelvis

Should the stone be thus located it may be removed at once by prolonging the incision or by making a separate anterior wound if the stone is low down thus the liability to ventral hernia is diminished and an easier and more direct access obtained but in some cases it may be wise to delay the removal of the calculus for the condition of the patient may be too critical to allow a prolongation of the operation The surgeon must then establish a temporary urinary fistula in the loin

(2) *Impaction of a Calculus in the Pelvic Portion of the Ureter* In the male, the upper part of the pelvic ureter can be exposed by a prolongation of the lumbar incision already made for exploring the kidney as recommended by Morris Should the patient, however, be fat and the lumbar incision already very deep, this method will be found to be ex

tremely difficult and even dangerous. It is easier and safer to displace inwards the lower part of the rectus muscle and the parietal peritoneum, thus exposing the affected part of the ureter.

This incision has the following advantages :

It gives a very good view, which is unspoilt by hæmorrhage. It is extraperitoneal, at least as regards the incision into the ureter. It is not very difficult to any one with a sound knowledge of anatomy. The risks of hernia and of injury of the cord are less than after the oblique inguinal incision used by some surgeons. Drainage is easily established.

The ureter is to be sought in the mesial aspect of the wound, attached

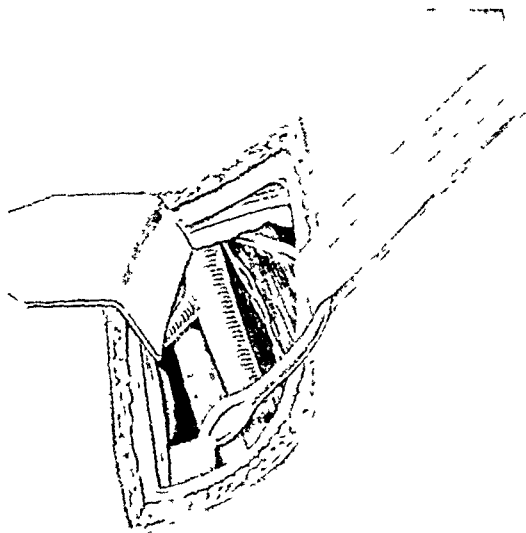


FIG. 202. Removal of stone from the lower end of the left ureter, the rectus and peritoneum having been drawn inwards. The ureter, bladder and iliac vessels are displayed.

to the displaced peritoneum. A ureteral catheter, or a sound in the bladder, may give valuable aid. Thus a low stone may be more easily found and the ureter containing it may be pushed upward into a more accessible position. Gentle endeavours may be made to push the stone upward into a more dilated, healthy and visible part of the ureter. Care must be taken, however, not to use force, lest the ureter be damaged : in one of Israel's cases (quoted by Morris) the duct was torn across. Attempts to crush the stone are not likely to succeed and may injure the ureter. The stone can rarely be pushed on into the bladder because of the very small size of the ureteral orifice, and, moreover, it would be difficult to tell whether the calculus had really reached the interior of the bladder or had merely passed into the submucous parts of the ureter. When the calculus cannot be dislodged, an incision is made into the accessible part of the

ureter above it for the introduction of a suitable scoop which usually dislodges and removes the stone. Before sewing the longitudinal incision in the ureter, a bougie must be passed down into the bladder and up to the kidney to prove the passage clear and to dilate any stricture especially at the vesical orifice. Sutures are not essential and sometimes it may be a very difficult and tedious task to insert them but whenever possible they should be used for the leakage may be at least diminished if not prevented entirely in some cases. The risks of extravasation and delay of recovery may thus be avoided. Fine catgut is the best material. The sutures should be so passed as to avoid narrowing the channel (Fig. 297). In any case drainage of the parietal wound is essential for it is difficult to close the ureter accurately in the depth of the wound and leakage may occur even after the most careful suturing. The fine rubber tube used for this purpose should not reach the ureter for this would prevent the latter from becoming surrounded by extraperitoneal fat would delay healing and would encourage the formation of a fistula.

Sir Arbuthnot Lane¹ opened the peritoneum in front and thus found a stone in the lower ureter displaced it upwards and removed it extraperitoneally through a small incision in the flank. Witherspoon² has adopted a similar plan exploring both kidneys and ureters intraperitoneally and removing any stone extraperitoneally after closing the peritoneum.

Gibbon³ has adopted a similar method, except that he does not suture the parietal peritoneum until he has extracted the stone which he pushes up into the extraperitoneal wound by means of a finger within the peritoneal cavity. He records two cases in which he successfully adopted this method after discovering ureteral stones during exploration in patients who had been sent to him supposed to be suffering from appendicitis. The appendix and the stone were removed in each case and both patients did well but there is little doubt that it is safer to sew up the peritoneum (if opened at all) before incising a tube which may have septic contents in cases of calculous obstruction. The writer after removing a subacutely inflamed appendix felt a stone in the left ureter near the pelvic brim and removed it through an extraperitoneal grid incision over the left iliac fossa.

Simpson⁴ approaches the lower ureter extraperitoneally through a low gridiron or muscular separation incision in the groin and recommends the adoption of either this or the incision through the rectus.

Very rarely is it wise or safe to remove a calculus from the ureter through the peritoneum for the risk of infection and of death is greater and the intestines are an embarrassment during the operation and may become adherent and cause trouble afterwards.

(3) *Impaction at or near the Vesical Orifice* In these cases the symptoms may very closely resemble those of stone in the bladder or cystitis. Judicious use of the cystoscope and bimanual pelvic examination should prevent the error. The mistaken diagnosis may be supported by the use of the sound which may touch the projecting part of the calculus.

¹ *Lancet* 1890 ii 96

² *New York Med Journ* May 31 1904

³ *Ann of Surg* 1906 xi 1 742

⁴ *Ann of Surg* 1905 xi 1 17

Freyer¹ relates three cases of this kind. The shadow cast by a ureteral stone does not move when the patient is turned from side to side, whereas that of a vesical stone shifts inside the more capacious bladder.

The vesical route is the best in these cases, the urethra being dilated in the female. Successful results have been recorded by Emmet, Berg, Richmond, Czerny, Sanger, Thornton, Freyer and others. Millet evaginated the ureteral orifice through the female urethra, by means of a finger in the vagina, and he was then able to extract the stone.²

In some cases a fine alligator forceps can be introduced through the female urethra by the side of the cystoscope and used to remove a stone from the ureteral orifice. Gellham records a case of this kind.³

In the male the stones are best removed through the operating cystoscope or, failing this, by suprapubic cystotomy. Morris refers to five cases in which this method was successfully adopted. Tuffier has also removed stones in this position twice by suprapubic cystotomy. Crawford⁴ succeeded in extracting a calculus measuring 1½ inches in diameter in this way. Freyer⁵ removed ureteral stones in two cases through a perineal lithotomy wound, undertaken for the removal of vesical stones for which the calculi had been mistaken by the use of the sound.

After several attempts Freyer⁵ was able to grasp and remove a stone from the ureteral orifice of a man by means of a lithotrite, which was then used to crush it. The calculus had been localised by means of the cystoscope.

It may be necessary to incise the mucous membrane or even the muscular wall of the bladder in order to free the calculus.

(4) *Impaction low in the Pelvis, but not accessible from the Bladder.*

The experiences of Israel, Young,⁶ Finney, Betham Robinson⁷ and others have proved that it is possible to remove a calculus from any part of the ureter down to the bladder wall through an iliac incision. It may not be always wise to choose this route, however, for it may not be the easiest or the safest method to adopt in certain cases for various reasons. In most cases it should be adopted, however, because the kidney and ureter can be examined at the same time.

The Vaginal Route. Emmet, Cabot, Israel, Garceau and others have successfully removed ureteral calculi through the vagina. It may be suitable for some cases in which the calculus is low down.

Garceau⁸ removed a stone impacted about three inches from the vesical orifice by incising the anterior vaginal cul de sac, pushing away the peritoneum from between the bladder and the uterus and then everting the broad ligament backwards and hooking the calculus and the ureter downwards and forwards towards the vagina. A small vaginal incision was then made and the calculus squeezed out; the incision was closed with sutures, which took up the outer coats of the ureter. The operation

¹ *Lancet*, 1903, ii, 583.

² Deaver, *loc. cit.*

³ *Surg. Gyn. and Obst.*, November, 1911, p. 578.

⁴ *Amer. Med.*, 1904, ii, 791.

⁵ *Surg. Diseases of the Urinary Organs*, 1908, p. 363.

⁶ *Ann. of Surg.*, 1903, xxxvii, 682.

⁷ *Lancet*, 1905, i, 495.

⁸ *Boston Med. and Surg. Journ.*, April 21, 1904.

took only ten minutes and was entirely successful, no fistula resulting. The stone was a large one, having a diameter of three eighths of an inch.

This method carries the risk of pelvic cellulitis, which occurred in a case recorded by Freyer.¹

In this case Freyer was unable to extract the calculus, because it slipped up out of his reach, but it came away into the dressings. Pelvic cellulitis supervened and delayed the recovery of the patient. A temporary or permanent uretero vaginal fistula may also arise after this operation. Israel (quoted by Young), although he was able to remove two stones by this route, failed in two other cases and had to resort to the iliac incision, which proved successful. Therefore Israel did not attempt the vaginal operation in his two next cases.

Prognosis. Extraperitoneal uretero lithotomy is a very successful operation having a mortality of about 2 per cent. With earlier and more accurate diagnosis, the operation will not only have a lower mortality but will also save more kidneys from destruction by long continued backward pressure and sepsis. Sir J. Thomson Walker² gives the mortality of transperitoneal uretero lithotomy as 5.5 per cent.

II VALVULAR OBSTRUCTION. Simon, in 1876, gave theoretical directions for the relief of this condition. The first successful operation was performed by Fenger, of Chicago, in 1892. The method of dealing with the condition may be gathered from the following *résumé* of Fenger's case.³ The patient was a woman, aged 28, with intermittent hydronephrosis and a movable kidney. The pelvis and calyces were first explored and no stone found. As the ureter could not be catheterised, a small opening was made in the posterior wall of the infundibulum, when a valvular obstruction was found at the upper end of the ureter where it joined the renal pelvis. The valve was divided vertically, and the ends of the longitudinal incision united by sutures, so as to convert the incision into a transverse one. The incision in the infundibulum was then closed with sutures and the kidney fixed in the loin, a bougie being passed through the wound in the renal parenchyma and retained in position in the ureter for two days. The patient recovered without a fistula and subsequently had no return of the hydronephrosis.

Morris⁴ did not recommend leaving the bougie, for there is little

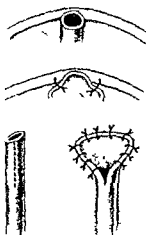


FIG. 293. Kuster's operation. A shows transverse sections of the dilated pelvis and ureter which is slit open and sewn to the pelvis. B shows the slit ureter before and after it is sewn to the wall of the pelvis on the inner side.

¹ *Loc. supra cit.* p. 360.

² *Genito-Urinary Surgery* p. 333.

³ *Ann. of Surg.* 1894, xx.

⁴ *Loc. cit.* ii, 435.

fear of stenosis resulting if the ureter be of normal calibre: "It delays healing, and it is liable to be followed by a temporary fistula. It is apt to excite ureteritis, and there may be marked difficulty in removing it owing to deposit of urinary salts upon it."

If the ureter be found to be adherent to the dilated pelvis and opening into the latter too high for efficient drainage, a plastic operation should be undertaken. The valve or bridge between the lower end of the pelvis and the ureter should be incised from within the pelvis, which should be opened by a posterior vertical incision.

Recurrence of the malformation should be prevented by carefully

suturing the edges of the incision in the septum in a longitudinal direction, as recommended by Mynter,¹ or by sewing the flaps to the inner surface of the sac (Küster). The simplest way, however, is to excise the flaps. The exploratory incision in the pelvis should then be closed with fine cat-gut sutures.

If the method recommended above is not practicable because the ureter is not adherent to the dependent part of the hydronephrotic sac, an incision may be made at the lowest point of the sac, and its edges joined to a longitudinal wound made in the ureter. The sutures should only pierce the outer coats of the sac and ureter. This method is not applicable when a narrow stricture exists in the ureter below the



FIG 294. Abnormal position of ureter to hydronephrotic infundibulum of kidney before operation. The bougie could not be passed into the ureter through the kidney wound, therefore an incision was made in the pelvis. (After Henry Morris.)

lower end of the sac, and then a portion of the ureter may have to be resected and the healthy end joined to the lower part of the sac as in Küster's classical case. Küster's patient had a hydronephrosis of his only kidney draining in the loin, and Küster found first a valvular and elevated ureteral orifice, which he slit open; then he discovered a slight stricture in the ureter 2 c.m. below the sac. As this was not remediable it was resected, and the healthy end was attached to the lower end of the hydronephrotic sac, as shown in Fig. 293. It will be noticed that the outer surface of the ureter is attached to the denuded inner surface of the sac. The patient ultimately improved wonderfully in his general health and comfort. The fistula closed, although pus was present in the urine six months later.

Figures 295 and 296 illustrate a simple method of overcoming a valve

¹ *Ann. of Surg.*, December, 1893.

or stricture at the junction of the ureter and pelvis. Simple lateral anastomosis also serves the same purpose. Fine catgut is the safest suture material. Silk may form the nucleus of a stone and should not be used.

Morgan¹ has published a case of valvular obstruction situated about an inch and a half above the bladder. This malformation was probably due to kinking, which was again due to peri ureteral adhesions such as induce a similar condition in the œsophagus. Morgan divided the valve through an incision made extraperitoneally into the pouch. A supra-

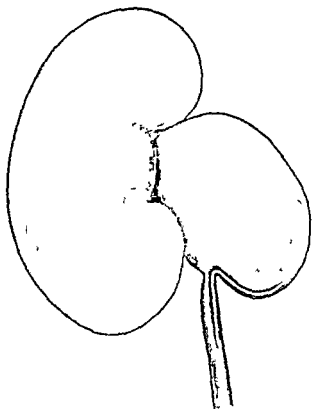


FIG. 295

pubic cystotomy was performed to pass catheters into the ureter to prevent recurrence and establish drainage. The patient ultimately made a good recovery.

III. STRICTURE OF THE URETER. Various plans have been adopted by different surgeons to remedy strictures of the ureter, the chief being the plastic method of Fenger,² dilatation by bougies (Alsberg) and resection of the strictured portion (Küster). The first of these plans only will be described here, as it will probably be found applicable to the greatest number of cases. Moreover, this method has been successfully carried out by Fenger, Morris, Mynter and others.

The details of the operation can be very well made out by reference to

¹ *Ann. of Surg.*, 1902, xxxvi, 528.

² *Loc. supra cit.*

Figs. 297 to 581. The strictured portion of the ureter is first divided longitudinally; sutures of fine catgut are then passed on either side of this in order to draw the two extremities of the incision together and thus convert it into a transverse one, after the manner of the Heineke-Mickulicz operation for stenosis of the pylorus. Further sutures, passing through the outer coats only, now bring the edges of the rest of the incision together, thus folding the ureter on itself to some extent.

The following short account of Fenger's case well illustrates the brilliant success of the operation:

“Traumatic stricture of ureter close to entrance into pelvis of kidney;

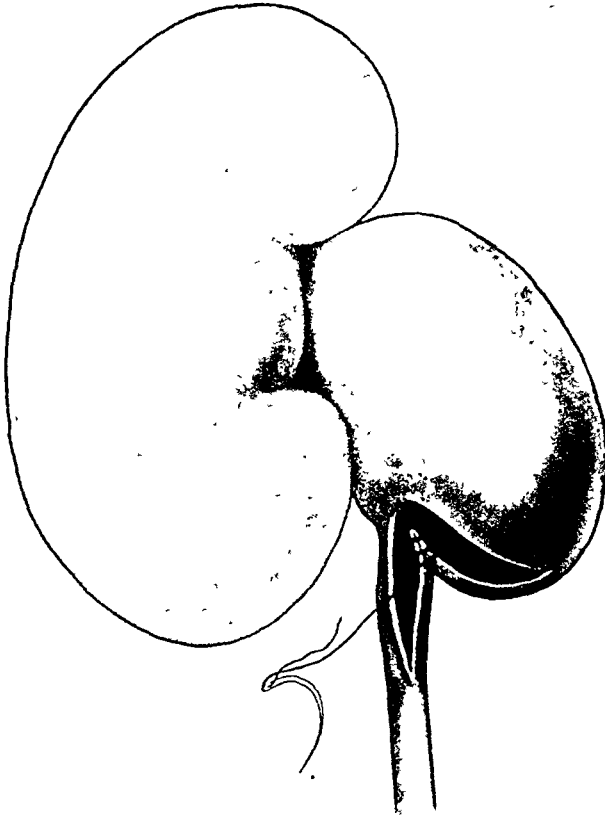


FIG. 296.

intermittent pyonephrosis for twenty-four years; increased frequency of attacks; nephrotomy; no stone in sacculated kidney; ureteral entrance could not be found; longitudinal ureterotomy revealed stricture at upper end of ureter; longitudinal division of stricture and plastic operation on ureter: recovery without fistula.”

Before performing any plastic operation upon the ureter or the pelvis, it is very important to decide (a) if the kidney is in a recoverable condition, and (b) if the ureter is patent throughout the rest of its course up and down. Much may have been learnt about the functional capacity of the kidney from an examination of the separated urines, but the most reliable evidence is an examination of the kidney from the wound. The

patency of the ureter must be determined by means of a bougie or ureteral catheter. These must be used at the beginning of all plastic operations and before completing all nephro lithotomies and uretero lithotomies. If these precautions are not taken the surgeon may waste time and energy in performing useless operations or fail to relieve his patients by incomplete ones. It should be remembered that stones and strictures of the ureter are often associated. The stone may be either the result or the cause of the stricture. Carcinomatous stricture may develop at or near an impacted stone.

In cases of extensive or multiple strictures of the ureter and in those due to tuberculous or malignant disease nephro ureterectomy may be

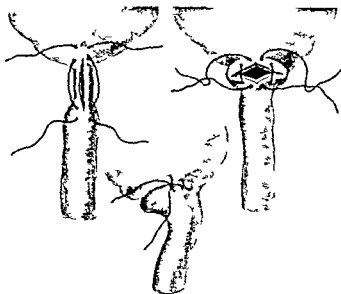


FIG 497 Fenger's operation for stricture of the ureter

the only suitable treatment if the other kidney is known to be sufficiently healthy. Failing this a fistula may be established in the loin.

Ureteral catheterisation and dilatation through the bladder has been successfully performed and cases have been published by Kelly, Pawlik, Casper and others. Morris condemned the treatment as a difficult, tedious, uncertain and painful process. Pawlik had to pass the instrument thirty times in his cases of pyonephrosis. Symptoms of fever and pain may be aggravated by each introduction.

Strictures of the lower ureter may be approached through an extra-peritoneal abdominal incision and treated in one of various ways.

Young¹ after removing a calculus impacted $1\frac{1}{2}$ cms. above the bladder was able to dilate a stricture which had developed below the calculus. In another case of the same kind Dr. Young removed a large calculus from the ureter just above the wall of the bladder. He then discovered an impervious intramural stricture which he was not able to dilate. He

¹ *Ann of Surg* 1903 xxxvi 688

therefore exposed the lateral wall of the bladder from the same iliac wound and, having retracted the vas deferens, opened the bladder. With the aid of digital counter-pressure at the ureteral orifice, he was able to force the point of a small urethral dilator into the bladder and then to divide the stricture from within the bladder by means of a long-handled scalpel. The patient made a rapid recovery, and the ureteral orifice was seen to be patent six months later, by means of the cystoscope.

Israel (quoted by Young), having performed a nephro-lithotomy on a woman and discovered a stricture in the pelvic ureter, attempted to dilate the stricture from the bladder; but failing, he exposed the ureter extraperitoneally and found a stricture about 3 cms. long ending at the bladder wall. He then resected the stricture and joined the healthy end of the ureter to an incision made on a sound high up on the posterior wall of the bladder. The ureter was cut obliquely, and its mucous membrane sutured to that of the bladder at one angle of the wound, which was then closed. The lumbar fistula, which had existed for eight months, soon closed. Before it closed Israel proved that fluid introduced into the bladder did not flow back through the new ureteral orifice, but a catheter could be passed from the fistula along the ureter into the bladder.

OBSTRUCTION OF THE URETER BY ABNORMAL RENAL BLOOD-VESSELS¹

The importance of kinking of the ureter over an abnormal blood-vessel as a cause of renal colic, hydronephrosis and stone in the kidney is considerable. In 1894 Newton Pitt² drew special attention to "aberrant renal vessels as a cause of hydronephrosis" and showed before the Pathological Society five specimens taken from the post-mortem room. Three of these are in the Guy's Hospital Museum (Spec. 1693, 1694, 1695), and the late Sir Henry Morris³ figured two of them in his classical work on *Surgical Diseases of the Kidney and Ureter*.

Commenting on these specimens, Newton Pitt said: "Though but few cases of hydronephrosis due to aberrant vessels have been recorded, it certainly is not very uncommon. This association is frequently overlooked, owing to the kidneys being removed singly from the body. Dr. Fagge refers to hydronephrosis due to a hypothetically misplaced vessel, but most authorities overlook it altogether. Sir William Roberts refers in his work on *Urinary and Renal Diseases* to two among fifty-two cases of hydronephrosis in which a supernumerary renal artery compressed the ureter near its origin. . . . As a practical point in operating upon cases of hydronephrosis without obvious cause, it would be worth while to examine the lower and posterior part of the pelvis, near the orifice of the ureter, for an aberrant vessel, and, if found, it might be ligatured and divided, probably with the best results."

In spite of these writings, so few practitioners know of this condition that it is usually overlooked for years; the patient suffers from repeated attacks of severe pain, and ultimately the affected kidney becomes

¹ The following is an abstract of an article by one of us (R. P. R.) in the *Guy's Hospital Reports*, 1922, lxxii, 315.

² *Trans. Path. Soc.*, 1894, xlv, 110.

³ *Surgical Diseases of the Kidney and Ureter*, ii, 297, Figs. 141, 142.

seriously damaged before relief is given by operation. Some of my patients had consulted a great many doctors and specialists before a correct diagnosis was made and a cure afforded by operation (see Case 2).

Dietl in 1864 described these crises in connection with movable kidney and attributed them to twisting or kinking of the renal vessels or ureter by the descent of the kidney. But Dietl's crises may occur without abnormal mobility of the kidney and they have nothing to do with obstruction of the renal vessels. They are due to obstruction of the ureter causing intermittent hydronephrosis. Mobility of the kidney primary or secondary to the hydronephrosis may aggravate the symptoms but

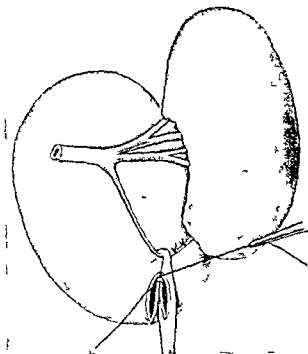


FIG. 293. Front view of left kidney showing obstruction of the ureter by an abnormal vessel. A branch of the renal artery hitches up the ureter at its origin. The division of the abnormal vessel is sufficient in mild cases, but a plastic operation or a short circuit is necessary in severe cases, as shown in the figure.

apart from obstruction of the ureter movable kidney is of little importance although many symptoms are wrongly attributed to it.

I have met this condition twelve times in the last twelve years. I published eight examples in 1917.¹ Congenital stricture with valve formation at the junction of the ureter and pelvis of the kidney is another important cause of similar symptoms which cannot be discussed fully here. These abnormalities will be found to be not uncommon if the pelvis and the ureter are carefully examined as a routine and essential part of every kidney operation. Nephropexy should never be performed until obstruction of the ureter has been definitely excluded as a cause of the symptoms.

¹ R. P. Rowlands *Brit. Med. Journ.* 1917, 1, 705.

Many failures of nephropexy are undoubtedly due to mistaken diagnosis. Similarly, nephrolithotomy is not likely to be permanently successful if the stone has been caused by an obstruction of the ureter which is not discovered and relieved at the operation.

The early recognition and treatment of this condition relieves the patient from frequent and disabling attacks of pain and saves the kidney from gradual destruction.

Pathology. The main renal vessels and their branches pass in front of the renal pelvis to reach the hilum of the kidney, but one of the four or five branches of the renal artery or vein usually passes behind the pelvis, as a rule at too high a level to obstruct the narrow outlet into the ureter. Occasionally, however, an abnormal renal vessel crosses the origin of the ureter on its way to the lower pole of the kidney. This is usually an abnormal posterior branch of the renal artery. Sometimes a similar tributary of the renal vein, and sometimes a vein and an artery, run together. Very rarely, an additional renal artery runs from the aorta to the lower end of the kidney. As a rule, but not invariably, the offending vessel lies behind and hitches up the origin of the ureter (Fig. 298). The abnormality appears to be about equally common in the two kidneys, and in males and females. In some cases the abnormal vessel crosses the ureter without obstructing it, but if the kidney is unusually movable some obstruction is likely to occur when the trunk is in the vertical position. This leads to gradual dilatation of the pelvis. Any dilatation and pouching of the pelvis is likely to increase the tension upon the artery and therefore to increase the obstruction. In the course of time, as the pelvis becomes more and more distended and as the heavier kidney descends more, the tense blood-vessel exerts more and more pressure on the ureter, inflaming it, and at last causing a real stricture at the site of constriction.

Symptoms and Signs. (1) Attacks of renal colic of increasing frequency and severity which may go on for years before the condition is recognised. As a rule, the patients are over twenty-five before an operation is considered, but the symptoms may begin in childhood (Case 2).

Exercise is apt to bring on these attacks of sudden spasmodic, characteristic, and severe pain, which runs from the loin downwards and inwards into the groin, and often into the testicle, which may be retracted. In some cases the pain runs down the front of the thigh; in a few it does not extend to the groin, but is a semi-girdle pain about the level of the umbilicus. As a rule, the pain is intolerable, the patient cannot sleep or lie still; nausea and vomiting are often associated with it, and there may be faintness, pallor, or even shivering. Generally there is some abnormality of micturition, usually increased frequency and irritability with a diminished quantity of urine. At first the urine, during and after an attack, is normal in character; later it may be albuminous or even contain blood or pus. Occasionally the amount of urine passed is increased just after an attack. Usually there is deep tenderness and rigidity in the loin during an attack, and sometimes in late cases a swelling can be felt descending below the costal margin on deep inspiration. Early attacks are often far less severe. Sometimes there is shivering and in late cases a rise of temperature.

(2) In the interval between the attacks there is at times a dull ache, a sense of fulness or a dragging pain in the loin.

(3) In time the general health deteriorates and the kidney becomes chronically distended palpable and tender

Diagnosis A *Renal colic has to be distinguished from other severe pains in this region* especially appendical biliary and intestinal colic. Appendical is rarely so severe as renal colic and is not often associated with urinary symptoms except when the appendix is low down near the bladder or is lying close to the ureter. As a rule there is tenderness over the appendix and more intestinal symptoms such as chronic indigestion and perhaps a slight elevation of temperature which is rare with renal colic. Intestinal colic due to lead is characterised by the lead line punctate basophilia and constipation and is mostly located about the umbilicus there is often generalised abdominal tenderness. The spasmodic attacks of pain with tenderness in the loin sometimes caused by posterior duodenal ulcer have led to an erroneous diagnosis of renal colic with exploration of the loin. Biliary colic is higher in position and chiefly located in the right hypochondriac and epigastric regions. Tenderness is just below the ninth costal cartilages except when the gall bladder is unusually low.

B *The various causes of renal colic have to be distinguished from each other*. Attention therefore may be drawn to some of the most important causes of obstruction of the ureter

(1) *Foreign bodies inside the ureter* Stone or gravel blood clot from injury growth or tuberculous disease of the kidney tuberculous debris blocking the narrow channel of a tuberculous ureter small hydatid cysts passing down the ureter

(2) *Changes in ureteral wall* Stricture congenital or acquired valve formation at junction of pelvis and ureter myoma or other growths of the ureter

(3) *Pressure upon the ureter* by abnormal blood vessels especially when the kidney is unduly movable growth especially of the uterus. I have known an abscess in the lower end of the only kidney completely and fatally obstruct the ureter

Of all these stone gives the most severe pain it is most frequently associated with bleeding and excess of crystals in the urine. Severe bleeding is quite rare with the other causes of renal colic except tuberculosis and growth of the kidney. Severe bleeding giving rise to colic is only occasional with tubercle the ureter is somewhat narrowed and clots or debris cannot pass easily through the strictured tube. A similar stricture of the ureter is sometimes due to bilharzia.

An X ray examination should always be made *but a negative report as regards stone in the ureter is not conclusive for many reasons*. A stone obstructing the ureter is usually small except when it is merely projecting into the ureter from the pelvis. The patients are often over middle age and somewhat stout. The stone may be composed of urates which cast but little shadow. I have operated on a number of cases and removed one or more stones from the ureter when the X ray report was negative. In one instance the patient had been radiographed five times at different hospitals and I removed a stone the size of a filbert from the upper part of his ureter. In these cases cystoscopy is of the greatest value. Two grains of indigo carmine are injected into a vein and a few minutes later coloured urine ought to be seen issuing from both ureters. The

absence or marked diminution of the stream from one ureter is of the greatest significance, and the loin should be explored. In some cases a stone is seen projecting into the bladder from the lower end of the ureter. In others, it can be felt just above the bladder through the anterior wall of the vagina.

Pyelography is of value in the diagnosis of early hydronephrosis and may help in localising the cause. Diminution of urine during the pain, with increase afterwards, is suggestive of hydronephrosis. In a few of these cases some swelling can be felt on careful examination during an attack, and the kidney is tender on palpation. Cystoscopy with the aid of indigo-carmin is also invaluable, especially during an attack. In some late cases the pelvis can be felt independently from and internal to the lower part of the kidney.

It is almost impossible to distinguish between an abnormal artery, a stricture or valve formation, and a small stone in the ureter as a cause of early hydronephrosis, and exploration is the only certain way of ascertaining the cause and treating the condition.

Treatment. Our aim should be to recognise and treat this interesting condition before the kidney, pelvis and ureter are seriously damaged. Secondary changes in the kidney unfortunately called for nephrectomy in one of my cases, as it probably has done in many other instances of hydronephrosis and pyonephrosis due to an abnormal vessel which was not discovered at the operation. Moreover, the changes in the pelvis and ureter demanded a plastic operation to ensure efficient drainage in half of my cases. How much simpler it is when division of the abnormal vessel is sufficient. When severe and long-continued pressure has caused a stricture to form at the origin of the ureter or extreme dilatation of the pelvis with relative elevation and valvulation of the ureteral orifice, a plastic operation is imperative. At first I performed Fenger's operation (after Finney's method of gastro-duodenostomy), but this is more difficult and not so satisfactory as making a short circuit between the lower part of the pelvic pouch and the ureter at the same level or a little lower down. With a shorter incision this ensures a better drainage from the lowest part of the pool, especially when the hydronephrosis is of large size. If the opening in the pelvis is round and also a little larger than the one in the ureter, a more patent channel is established. Nephrectomy should be reserved for extreme cases, where the renal cortex is thin or white or otherwise hopelessly damaged, for the regenerative powers of the kidney are wonderful under good conditions of drainage and asepsis. Excision of part of the dilated pelvis is rarely necessary, as, when well drained, it contracts rapidly.

CASE 1. Miss H., aged 36, sent by Dr. Halstead of Ramsgate for a large swelling in the left side of the abdomen. The patient says that for five or six years she has had attacks of pain in the left loin and shooting down towards the groin. Sometimes the pain has been very severe and has only been relieved by morphia. No blood, pus or small stone has ever been noticed in the urine. About two years ago a distinguished surgeon at Chester diagnosed movable kidney and ordered a kidney support, which has been worn ever since without much relief. During the pain a swelling appeared in the left groin, but this usually disappeared when the patient lay down. About a month ago a very severe attack developed, and then a very large swelling appeared in the left flank, which hardly moved upon respiration and has not diminished since then. So large and so firm was it that it was at first thought to be a growth. The

urine was normal. The swelling was mostly resonant in front and was thought to be a distended pelvis. An X ray examination had failed to show any stone.

Operat on o: September 16 1911 Dr Fisk assisted and Dr Halstead gave the anæsthetic. Before the anæsthetic an injection of two grains of indigo carmine was made into the muscles of the right thigh the cystoscope passed into the bladder containing urine and the two ureters watched. Nothing issued from the left ureter but in about eight minutes pigment came away from the right. On further watching at the end of twenty minutes nothing came from the left. The pigment did not come very rapidly from the right. The patient was then anæsthetised after the bladder had been emptied, and turned on the right side over a large kidney pillow. The usual incision in the loin was made and the kidney was found to be enormously enlarged. With some difficulty it was shelled from its surroundings and delivered into the wound and then it was noticed that the obstruction to the ureter was due to the hooking of an artery extending into the lower pole of the kidney in front of the beginning of the ureter the pelvis having descended in front of this abnormal vessel. The obstruction was complete. The ureter itself was natural. On ligaturing and dividing the vessel the junction of the ureter and pelvis was seen to be natural and not narrowed although there were some adhesions. With a little difficulty the urine was squeezed from the kidney to the bladder without incising the kidney or pelvis. The urine seemed clear as seen from the hugely distended pelvis. When the kidney had been quite emptied nephropexy was performed with four catgut sutures in the usual way. The kidney tissues seemed fairly good although greatly expanded and in view of the mobility and imperfection of the right kidney it was deemed inadvisable to remove a fairly good left. The patient stood the operation well and made a good recovery although there was some suppuration in the wound.

CASE 2 Right hydronephrosis Mr A M aged 18½ described his illness as having started at the age of eight or nine years, severe attacks of pain occurring every two to three weeks. During the next ten years many X ray examinations were made with negative results and many doctors consulted but no definite conclusion was arrived at as to the cause of the symptoms. The attacks now increased in severity and lasted from five to seven days morphia having to be given for the relief of pain. The urine was normal. At the beginning of 1920 a urologist after pyelography diagnosed hydronephrosis and advised immediate removal of the right kidney but a physician who suspected a stricture or kink of the ureter brought the patient to me. We diagnosed hydronephrosis due to an aberrant renal vessel or valvulation of the origin of the ureter. The patient's father then took him abroad to consult various Continental experts. Dr — of Brussels diagnosed auto-intoxication and strongly recommended medical treatment, while Professor I of Berlin after very thorough examinations recommended nephrectomy as an imperative necessity. The patient returned to London and saw several more consultants. In all he had consulted about twenty medical men before he asked me to operate.

On September 28 1920 I found that no urine issued from the right ureter. At the operation immediately afterwards an abnormal vein was discovered behind the ureter linking it just below the renal pelvis which was moderately dilated. The kidney was in good condition. The vein was divided and the patient made a good recovery. He has remained well for six years and has led a very active life since the operation.

B Injuries to the Ureter These may be met with either in the form of traumatic ruptures or of accidental division or removal of a piece of the ureter during the course of certain abdominal operations such as hysterectomy or the removal of any pelvic tumour.

Traumatic rupture of the ureter has rarely been treated by direct suture. This is owing doubtless to the extreme difficulty in the diagnosis of this condition in the early stages for most of the cases have not been recognised until an accumulation of urine blood or pus has formed and has been opened. The tumour due to the accumulation may not be noticed for some time two to three weeks (Stanley Page Barker Hicks) thirty nine days (Croft) and in one case (Stanley s) not until seven

weeks after the injury. The following is an interesting case successfully treated by early operation by the author.¹

A youth, aged 18, was admitted into Guy's Hospital complaining of great pain in the left side of the abdomen. Two days before admission, whilst walking along the pavement with his left hand in his pocket, he fell on his left elbow, his hand being driven against the lower part of the abdomen and causing an agonising pain shooting up to the left loin. Gradually a swelling appeared on the left side of the abdomen, and the patient was sick several times. On admission the temperature was 102, and pulse 110 to 120. The lower part of the abdomen moved but little on respiration; the left iliac fossa was fuller and less resonant than natural and very tender. If the local signs had been on the right side, his general and local condition would have agreed well with an attack of appendicitis. There was some tenderness and fulness in the left loin posteriorly. The bowels were constipated, the urine and the act of micturition were normal. The viscera were not transposed.

The abdomen was explored through the lower part of the left rectus. Some clear fluid escaped, but there was no septic peritonitis, and the appendix was normal. The retro-peritoneal tissue and the left meso-colon were very œdematous, with a greenish translucent appearance. The swelling extended up to the left kidney, which appeared to be normal in size and consistency. The abdomen was closed, the patient turned over on to his right side and the left kidney explored. On opening the perirenal tissue a good deal of slightly blood-stained fluid escaped. With some difficulty the kidney and the upper part of the ureter were isolated, and a clot of blood was seen plugging a large rent at the junction of the ureter and the renal pelvis inferiorly. The laceration extended nearly all the way round, a small part still remaining undivided at the upper and inner part of the tube. The clot had obstructed the lumen of the ureter. The rent was sutured with fine catgut in such a way that no narrowing of the lumen of the ureter resulted. This was not easy because of the depth of the wound and the great amount of œdema of the surrounding tissues which kept flapping into the way. The loin was drained by means of a large cigarette drain, and the wound closed all round. The patient made a good recovery and was seen about two years after the accident perfectly well.

Sir Henry Morris² was only able to discover records of twelve cases of rupture of the ureter as distinguished from rupture of the renal pelvis. Should a traumatic rupture be discovered during an exploration, it should be treated by suture or anastomosis.

The accumulated fluid in the loin has been aspirated in some cases several times with ultimate recovery, probably at the expense of atrophy of the kidney in most cases.

Lumbar incision is far preferable, and thus drainage at least will be established to prevent further extravasation and suppuration. In some of these late cases it may be possible to perform a plastic operation on the ureter. If it be known that the opposite kidney is in good working order, a secondary nephrectomy may be performed for suppuration in and around the kidney, or for persistent fistula.

Primary nephrectomy is not justifiable, for the kidney and ureter may recover their functions, and knowledge is first needed concerning the presence and function of the other kidney.

For accidental division or removal of a piece of the ureter during the course of an abdominal operation, a very large number of different operations have been performed. It is impossible here to mention or describe all of them. An attempt will, however, be made to indicate the methods which are likely to be found most suitable to the various conditions that may be met with.

¹ R. P. Rowlands, *The Medical Press*, April, 1909, p. 404.

² *Loc. cit.*, ii, 300.

In the great majority of instances it will be found possible to unite the divided ends of the ureter. The results that have so far attended the various methods of bringing this about clearly show that it should be done wherever possible. Bovee¹ mentions twenty seven published cases with only two deaths and not in one was there failure to unite. If the ureter has been simply divided without loss of substance and if both the ends are accessible and the upper end will not reach the bladder, then, because it is the most simple method to carry out and because it is the least likely to be followed by stricture the following operation, devised by Van Hook (see Fig 299) should be performed. The following are the steps of the operation as given by Fenger²:

End to Side Union. (1) Ligate the lower portion of the tube one eighth or one fourth of an inch from the free end. Make with fine sharp-pointed scissors a longitudinal incision twice as long as the diameter of

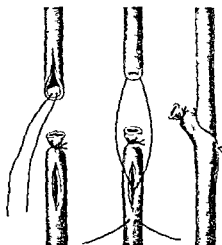


FIG. 299. End-to-side anastomosis of the ureter. Van Hook's method.

the ureter in the wall of the lower end one fourth of an inch below the ligature.

"(2) Make an incision with the scissors in the upper portion of the ureter, beginning at the open end of the duct and carrying it up one fourth of an inch. This incision ensures the patency of the tube.

"(3) Pass two very small cambric sewing needles armed with one thread of sterilised catgut through the wall of the upper end of the ureter, one eighth of an inch from the extremity from within outward, the needles being from one sixteenth to one eighth of an inch apart, and equidistant from the end of the duct. It will be seen that the loop of catgut between the needles firmly grasps the upper end of the ureter.

"(4) These needles are now carried through the slit in the side of the lower end of the ureter into and down the tube for one-half an inch, where they are pushed through the wall of the duct side by side.

"(5) It will now be seen that traction upon this catgut loop passing

¹ *Ann. of Surg.*, August 1900.

² *Loc. supra cit.*

through the wall of the ureter will draw the upper fragment of the duct into the lower portion. This being done, the ends of the loop are tied together securely, and as the catgut will be absorbed in a few days, calculi do not form to obstruct the passage of the urine.

"(6) The ureter is now enveloped carefully with peritoneum."

Lateral Anastomosis. In some cases this can be carried out after tying both cut ends. A larger opening can be made in this way.

End to End Suture. If, however, a portion of the ureter has been accidentally removed and the upper end will not reach the bladder, it will probably be found that there will not be sufficient length of ureter available for performing Van Hook's operation. In this case the ends must be united by end-to-end suture, or by the oblique method of Bovée (see Fig. 300). Stricture is not so likely to follow as after transverse end-to-end or end-in-end methods of Schopf and Poggi respectively.

Uretero-Vesical Grafting. Should it be found that the upper end of

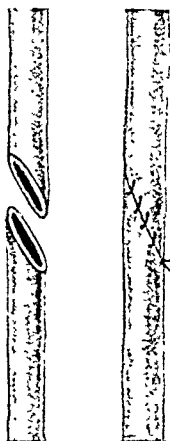


FIG. 300. Oblique end-to-end union of the ureter.

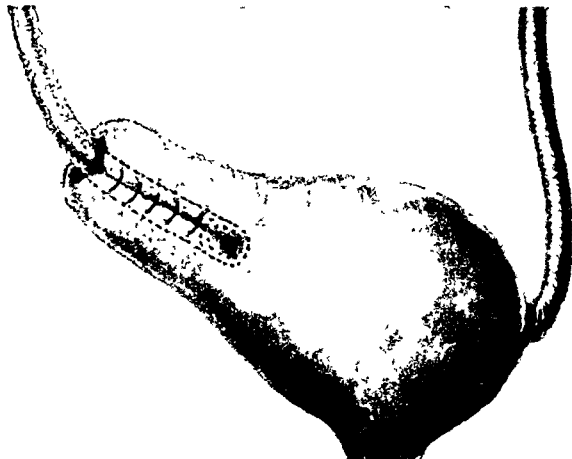


FIG. 301. Implantation of the ureter into the bladder (Witzel's method).

the divided ureter will reach the bladder, implantation into this organ is preferable to all other procedures. This may be carried out by some modification of the method of Paoli and Busachi,¹ which consists in splitting the distal end of the ureter and uniting it by sutures to an incision in the bladder, or by a modification of the operation of Van Hook for uretero-ureterostomy, the cut end of the ureter being invaginated into the bladder. This method has been adopted by Penrose and others.² If possible the operation should be performed extraperitoneally as in Witzel's operation.³ Witzel displaced and fixed the bladder into the iliac fossa, in order to enable him to bury the ureter for a distance 4 cm. in the bladder wall as shown in the figure. The mucous membranes of the incision in the bladder and of the oblique opening in the ureter were joined with interrupted catgut sutures, and the external coats were also joined with sutures (see Fig. 301). It is better to place the lower end of the

¹ *Annales des Maladies des Organes Genito-urinaires*, 1838.

² *Med. News*, 1894, lxi, 470.

³ *Centralblatt für Gynäkologie*, 1896, No. ii, p. 289.

ureter in the submucosa for some distance before it pierces the mucosa, thus imitating Nature's method of valve formation to protect the kidney from backward pressure and infection.

Resection of a growth of the bladder involving the ureteral orifice makes it necessary to join the shortened ureter to the bladder from *within the latter*. Before the separated ureter is divided it is transfixed with catgut, which is divided later and used to secure it to the upper angle of the posterior vesical wound, which is then closed with catgut, except near the ureter, where a tube passes from the retro vesical space through the anterior vesical wound to the surface. This tube serves a double purpose—*drainage of the opened cellular tissues and the maintenance of a free passage for the ureter*. When the tube is removed and its track heals the contraction of scar tissue draws open the ureteral orifice. Stric

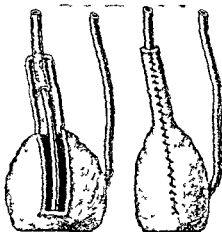


FIG. 302 Boari's operation. A flap from the anterior wall of the bladder is used as a substitute for the lower part of the ureter.

ture, the commonest cause of failure, is thus avoided as shown by the cystoscope months later (Thomson Walker).

Boari¹ has described and figured an ingenious plan of raising an extraperitoneal flap from the anterior wall of the bladder, joining its edges and implanting the ureter into the tube thus formed. This method may be found useful when displacement of the bladder is not enough to allow of union without tension. Van Hook has described a similar method, the ureter had been previously implanted upon the skin of the abdomen.

Finally, should such a length of ureter have been removed as to render both direct union of the two ends and implantation into the bladder impossible the proximal end may be either ligatured (causing atrophy of the kidney), or implanted into the bowel or on the skin. The results of implantation have so far been on the whole extremely unsatisfactory, owing to infection of the ureter and kidney in the case of implantation into the bowel, and to discomfort and constant irritation of the skin when the implantation is made on the skin. For these reasons a secondary nephrectomy will often be necessary in such cases.

¹ *Loc. cit.*

R. C. Coffey has, however, introduced an excellent and hopeful method of valvular implantation of the ureter into the colon. The following is his own description : ¹

"The technique of the operation is as follows : A cathartic is given the night before operation. The abdomen is opened near the median line. A rectal tube is passed up into the pelvic colon to a point where it is desirable to implant the left ureter. This tube drains away all gas and any possible faecal matter which may be present and makes unnecessary the use of clamps. The left ureter is exposed and ligated between forceps.

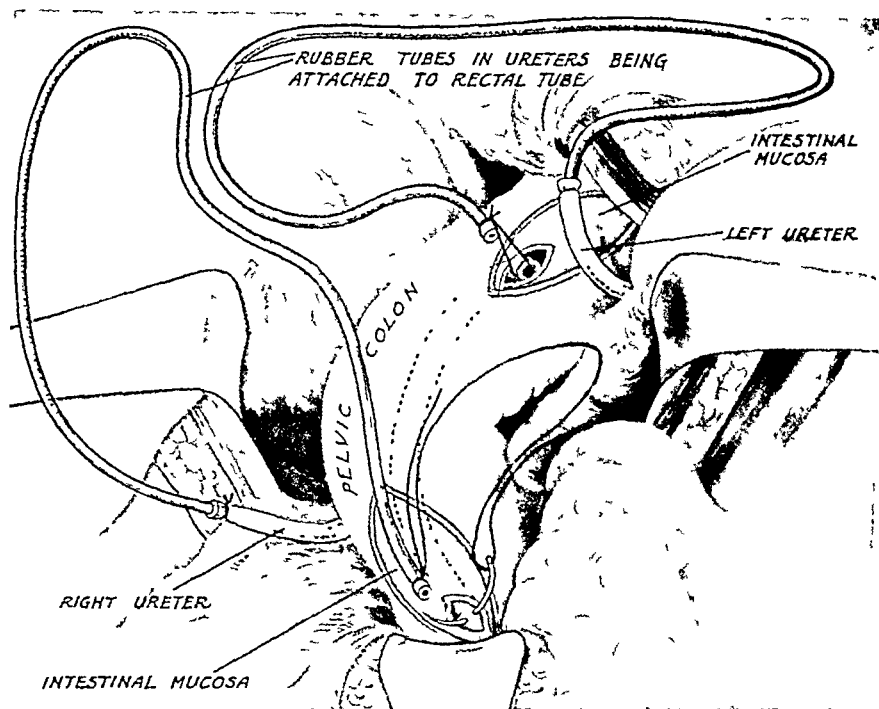


FIG 303 Simultaneous implantation of right and left ureters. The two ureters have been severed and long rubber tubes fastened in them for temporary drainage of the kidneys, tubes being attached to rectal tube in bowel by which the ends of the small tube will be drawn out through the anus and placed in a container. The end of the ureter will be drawn down and implanted in the intestinal wall outside the mucosa. (After Coffey.)

The distal end is cauterised with carbolic acid and dropped back into its place. Into the proximal end is fastened a very small rubber tube two or more feet in length. This is done by passing a small straight needle armed with linen thread through the wall of the ureter and including barely enough of the tube to hold. Then tie the thread around both tube and ureter sufficiently tight to control the urine and later to cause sloughing of the tied end. The right ureter is then treated in the same manner. It will be found that the urine is discharging through both of these tubes. Next the intestine on the left side is lifted at a point where the ureter may be inserted without tension or strain. Gauze is packed on either side of

¹ *Northwest Medicine*, May, 1925.

intestine so that any possible leakage from the intestine will be caught. An incision about one and one half inches long is made near the centre of the free margin of the large intestine and made to curve over to the outer side. This incision goes through the peritoneum and muscle and the mucosa is carefully freed from the muscularis allowing the mucosa to pouch out through the incision in the muscular wall. The same is performed lower down the intestine on the right side. A small stab wound is made through the mucosa at the lower angle of the intestinal wound and the end of the small rubber tube is attached by a linen suture to the end of the rectal tube. On the right side a small incision is made in the mucosa and the end of the right ureteral tube is attached to the side of the rectal tube. A nurse then pulls down on the rectal tube and draws the two ureteral tubes down until the ends of the ureters are drawn well within the lumen of the intestine. The ureters containing the tubes now lie directly on and outside of the loose mucosa of the intestine. The wall of the intestine on either side of the cut forming the two lips of the wound is drawn across the ureter and some of the sutures are made to penetrate the outer coat of the ureter. These sutures should be interrupted and of chromic catgut. Finally a continuous chromic catgut suture should roll the intestinal wall over the implanted ureter in order to make a strong intestinal wall. The abdomen is closed. The tubes protruding from the rectum are cut to the proper length and placed in a container for the urine. The kidneys function without even temporary cessation as if no operation had been performed. The tubes come away in about a week. The swelling in the intestinal wall has subsided and the implantation is complete.

CHAPTER XXIV

OPERATIONS UPON THE BLADDER

RUPTURE OF THE BLADDER

THIS used to be a most fatal accident; thus out of 143 cases of intraperitoneal rupture collected by Ullmann in 1886, only 2 recovered, and only 20 out of 94 cases of extraperitoneal laceration got well.¹

The late Sir William MacCormac was the first to publish two successful operations for intraperitoneal rupture.² Many successful operations have been recorded since then. Alexander³ and Jones⁴ collected 54 cases of intraperitoneal rupture, with a mortality of 63·5 per cent. before 1893, and 27·5 per cent. since 1893.

Ashhurst⁵ has collected 110 cases, with a death-rate of 42·72 per cent.

Exploratory operations and suture of the bladder will be increasingly successful in favourable cases, *i.e.* those seen early and those in which the injury is limited to the bladder.

Two forms of rupture are recognised—the intra- and extra-peritoneal, but in some cases the tear extends to both the intra- and the extra-peritoneal surfaces; occasionally two lacerations may co-exist, and one of them is very likely to be overlooked. It may be well succinctly to state the symptoms.

Intraperitoneal Rupture. (1) History of a likely injury, such as a kick or fall on a full bladder. (2) Inability to pass water.⁶ This power has, however, been preserved in both varieties: naturally it is retained more frequently and more completely in extraperitoneal cases; it is very rarely normal in the intraperitoneal ruptures. Attempts at micturition may be frequent and painful, but only blood-stained fluid may be voided in small quantities. (3) A little bloody urine drawn off with a catheter. (4) Difficulty of manipulating an instrument in a contracted bladder. (5) If the catheter, hitting off the rent, be passed beyond the bladder, a much larger quantity of blood-stained fluid is withdrawn, partly urine, partly serum, from irritation of the peritoneum. If the flow through the catheter is markedly increased by inspiration and diminished by expiration the rent is probably a large one.

(6) Shock. This may be absent or pass unnoticed in patients who are intoxicated at the time of the accident and, as the laceration frequently occurs under these circumstances, this fact is important to bear in mind.

This form of rupture commonly follows a kick or a blow upon the

¹ Von Bergmann, v, 452.

² *Lancet*, 1886, ii., 118.

³ *Ann. of Surg.*, 1901, xxxiv, 209.

⁴ *Ibid.*, 1903, xxxvii, 215.

⁵ *Amer. Journ. Med. Sci.*, July, 1906.

⁶ Thus the rent may be valvular or blocked by intestine, &c. On all these and many other points the reader should refer to Mr. Rivington's writings, *Dict. of Surg.*, i, 152, and *Rupture of the Urinary Bladder*, for exhaustive completeness and helpful information.

abdomen when the bladder is distended but it has also occurred spontaneously during the retention of urine from stricture enlargement of the prostate or any other obstruction It has also occurred during the crushing of vesical stones and in the course of perineal operations upon the bladder Bottini's galvano-cautery opened the peritoneum a good many times during the attempts to cauterise the enlarged prostate in the dark

(7) Speedy supervention of signs of peritoneal irritation viz pain in the lower part of the abdomen tenderness and rigidity The surgeon should not wait for the classical signs of peritonitis to manifest themselves Dr Quick records a case in which no peritonitis had developed after 10½ days The patient who was intoxicated at the time of the accident was able to work on the following day but he had to leave off on the second day on account of pain and vomiting He recovered after an operation performed on the eleventh day by Dr G F Thompson¹

In other cases in which the urine has been aseptic and no instruments have been passed the onset of peritonitis has been considerably delayed

(8) Perhaps fluctuation and shifting dullness in the flanks with abdominal distension and bulging of the pelvic peritoneum into the rectum

Extrapertoneal Rupture This is often due to or associated with fracture of the pelvis but it frequently happens when no such fracture exists It has followed repeated suprapubic aspiration (1) History of a likely injury (2) Difficulty in passing water (*vide supra*) (3) Bloody urine drawn off (4) The catheter finds the bladder contracted (5) No tapping of a larger amount of fluid (6) Evidence of extravasation rather than of peritonitis Thus, if the rent is in front the urine may be localised there with circumscribed dullness or widely diffused mounting up towards the umbilicus between the abdominal muscles and the peritoneum or passing into the iliac fossæ buttocks or by the canals into the scrotum and thighs In one case that I saw the extravasation was much more extensive upon the right side so that the situation of the rent was correctly diagnosed to be upon this side In another patient the late Davies Colley located the position of the extraperitoneal rent which was due to a fracture of the pelvis by the inability of the boy to flex and adduct his right thigh vertical fractures through the right ramus were found at the operation The patient soon becomes very ill with a quick pulse and respiration probably from reabsorption of urine from the connective tissues these symptoms appear while the extravasation is still sterile but sooner or later infection is bound to follow causing pelvic cellulitis

It must be remembered that the following may mislead There may be very little pain complained of no sickness a normal temperature the patient may be able to walk upwards of half a pint of urine may be drawn off night and morning and yet the peritoneal sac may contain much fluid Peritonitis may be absent post mortem though tympanites be present during life and though fluid be found in the peritoneal sac The patient may live as long as five days apparently unimproving and then die suddenly

Operation This must be undertaken without delay A free incision five or six inches long in the adult is made near the middle line below the

¹ *Ann of Surg* 1907 xlv 64.

umbilicus. The rectus sheath having been divided, the rectus drawn outwards and partly divided, if needful, and all bleeding points secured, the lower angle of the wound and the parts behind the pubes are carefully examined for ecchymosis, extravasation, &c. If neither of these nor any collection of fluid is found outside the peritoneum, this is opened, when a large gush of fluid may be decisive. The surgeon now introduces his left hand to feel for the rent, and the detection of this may be facilitated by passing a sound. The rent will vary in site and length, and also as to regularity, thickening, &c. If it be a long one and reach downwards towards the recto-vesical cul-de-sac, the Trendelenburg position should be adopted. This gives valuable assistance, for it grants a good view of the posterior surface and affords plenty of room for the introduction of sutures without risk of injuring the small intestines, which fall away and are protected with a sterile pad. A self-retaining retractor is inserted. An assistant may render service at this time by grasping the upper end of the bladder and drawing it forwards and a little to one side. A good light is essential. The rent, being now in view, is cleansed, and a continuous perforating catgut suture is inserted with a short curved needle and a good needleholder, owing to the depth of the wound and the limited space.

The catgut should be strong and tanned to last about 21 days. The sewing is begun at the front end of the rent. The tail thread is held up by the assistant, who holds the bladder well up in this way and facilitates the closing of the postero-inferior part of the laceration. A continuous Cushing sero-muscular suture of fine catgut now reinforces and buries the perforating suture (*see* Fig. 321). The gauze packs are removed, the pelvis is cleansed and the abdomen is closed in layers; but when there is peritonitis a temporary drain is left at the lower angle of the wound. A drain should be left in the prevesical space in extraperitoneal ruptures, especially if the operation has been deferred until it is difficult or impossible to find or suture the rent satisfactorily. As a rule a catheter should be tied in, care being taken not to pass too much of it into the bladder but to leave the eye only just above the vesical orifice. The bladder must not be allowed to get full, either from slipping or blocking of the catheter. In some early cases under constant observation, after accurate sewing, the patient may be left to void his own urine frequently or a catheter may be passed every six hours.

Cases occasionally occur where the neck and not the body of the bladder is lacerated, a fracture of the pelvis perhaps co-existing. Where there is inability to pass water and where, failing the cystoscope, it is uncertain whether a catheter enters the bladder, it will be best to explore the front and neck of the bladder by a suprapubic incision not opening the peritoneum. If blood-stained fluid wells up, and if the catheter be detected lying outside a full bladder, the latter should be opened and drained suprapubically to prevent any further escape of urine. The pelvic cellular tissues should be drained by the same route and sometimes perineally also.

In late cases with pelvic cellulitis free incisions must be made and drainage established.

Causes of Death. Peritonitis, shock, hæmorrhage, cellulitis.

Peritonitis is far the commonest cause of death, and it may be due to

infection from previously infected urine or from careless instrumentation, from infection at the operation or subsequent leakage due to inefficient suturing

TEMPORARY SUPRAPUBIC DRAINAGE

The following methods will be considered here

(i) **Aspiration**

(ii) **Suprapubic Puncture**

(i) **Aspiration** This may be used in cases of great urgency when the surgeon is compelled to relieve retention without regard to the cause when he is without the means of carrying out other and perhaps better methods, it is especially suited to those cases in which there is reason to believe

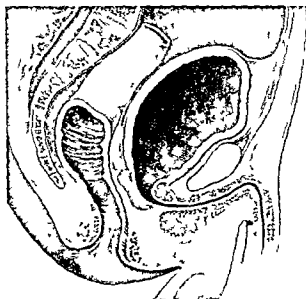


FIG. 304. Sagittal section of the pelvis the bladder being distended and the perivesical pouch of peritoneum well raised

that urine will again in a few hours be passed by the urethra either naturally or through a catheter. Thus in gonorrhoeal retention with prostatitis or prostatic abscess where a catheter cannot or should not be passed, or having perhaps been clumsily used and where relief is urgently required where retention has supervened on a stricture of only two or three years standing this means may be used successfully giving time for warm baths and opium to act. In an old stricture in one of traumatic origin or in a case of enlarged prostate it can only confer temporary relief and should be used only when other methods are not available.

The question arises *How far will aspiration bear repetition?* This is quite uncertain. On the one hand in a case of prostatic retention not admitting a catheter, the patient being throughout in a most grave condition Dr Brown¹ used the aspirator fifteen times between January 2 and 12 with immediate relief on every occasion and without the smallest inconvenience or injury from the punctures.

¹ *Brit. Med. Journ.*, May 23 1874

Mr. Hague,¹ in a patient aged 23, with prostatic retention of forty-eight hours' duration, aspirated, and continued to do so daily for nearly five weeks, as no catheter could be passed. Such numerous aspirations caused no ill effects. Young² mentions a case where the bladder was aspirated 100 times without harm.

On the other hand, in a case related by Mr. Jacobson of prostatic retention in which the aspirator had been used only three times, on the death of the patient from bronchitis on the fourth day the third and last puncture was found to be leaking. Dr. Campbell³ records a case in which the bladder had been aspirated twice, and internal urethrotomy then performed. "Progress was good for a day or two, when some inflammation appeared at one of the punctures, an abscess formed, peritonitis came on, and the man died." Where aspiration is to be used, the condition of the bladder walls and of the urine must be taken into account.⁴

If aspiration be made use of, a fine sharp needle of the calibre of an

exploring needle and at least 5 inches long should be employed and introduced just above the pubes, while an assistant steadies the bladder by pressure on either side. The needle is thrust backwards, with a slight inclination upwards, until urine escapes, which happens when the needle has penetrated from 2 to 4 inches from the skin. The urine is drawn off with an aspirator or large syringe. The bladder must not be allowed to become much distended before the puncture is repeated, otherwise urine may be forced out into the pelvic cellular tissues.

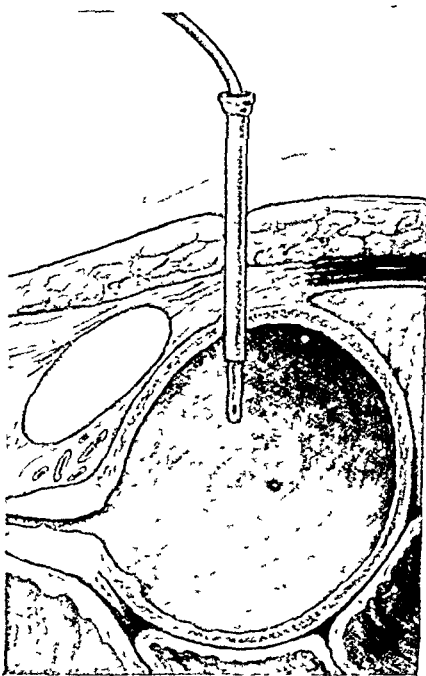


FIG. 305. Suprapubic puncture. A catheter is passed in through the cannula, the latter is withdrawn and the catheter is tied in.

(ii.) **Suprapubic Puncture with Trocar and Cannula.** This operation has the *advantages* of being easily performed, of giving permanent relief if desired, and of being safe in careful hands. The distended bladder must extend well above the pubis as shown by palpation and percussion, otherwise the peritoneum may be

opened and the bowel pierced with disastrous results (Fig. 305).

The two *objections* brought against it are—that (1) it gives bad drainage, and (2) it is liable to extravasation.⁵ Neither of these is borne out by facts. While the patient is in bed, good drainage can be pro-

¹ *Lancet*, 1885, ii, 385.

² H. H. Young, *Practice of Urology*, 1926, ii, 330.

³ *Brit. Med. Journ.*, February 21, 1886.

⁴ Mr. Bennett read a case before the Medico-Chirurgical Society (*Lancet*, 1888 i, 418) of extraperitoneal rupture of the bladder after aspiration in a patient long the subject of stricture. The opinion of most surgeons present seemed to be that aspiration was dangerously liable to leakage, especially in unhealthy bladders.

⁵ Mr. T. Smith (*St. Barthol. Hosp. Reports*, xvii, 291) writes: "I have seen no such tendency to extravasation; occasionally there is some inconvenience from leakage: this may be met by leaving out the cannula for a few hours, which allows recontraction to take place."

vided by turning him on one side and attaching tubing to the cannula when the patient is up (and a cannula so placed is no drawback to this) the power of micturition will probably have returned. In rare cases of enlarged cancerous prostate where a radical operation is impossible or is declined the patient will be compelled to pass his urine this way for the rest of his life but as soon as the parts are consolidated around the cannula (or the catheter which has replaced the cannula) micturition though tedious will be effected satisfactorily.

Operation This is most simple. Novocaine (0.75 per cent solution) is injected into the skin and deeply along the proposed track of the trocar. The cannula should be large enough to admit a No. 8 catheter and at least 5 inches long for the bladder lies deep in a fat patient. A median puncture having been made with the knife through the skin just above the shaved pubes the trocar is pushed backwards and slightly upwards until it is felt to enter the cavity of the distended bladder. The trocar is withdrawn and as the urine escapes a rubber catheter of suitable size is introduced through the cannula. When the point is well in the bladder the cannula is slipped out while the catheter is steadied. To prevent the patient from pulling it out I always sew it to the skin. A long rubber tube is fixed to the catheter and the urine is thus conducted to the bottom of a vessel filled with antiseptic solution placed under the bed or into a rubber urinal which must be kept scrupulously clean and aseptic.

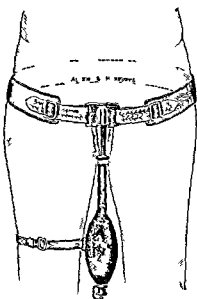


FIG. 306 Thomson Walker's supra-pubic drainage apparatus

PERMANENT SUPRAPUBIC DRAINAGE

This may be required for irremovable malignant growths of the bladder or prostate and has been adopted for enlargement of the prostate in very feeble old men when a catheter cannot be used or the risk of a radical operation is not accepted (Fig. 306).

A soft rubber catheter (No. 12) is inserted in the supra-pubic fistula so that its end projects about two inches into the bladder. This is held in position and leakage prevented by means of a silver plate accurately fitted to the supra-pubic region and kept in position by a belt. The rubber catheter when stretched passes through the silver tube attached to the plate but when relaxed it fits accurately and is kept in position. When the supra-pubic sinus dilates so that some urine leaks by the side of the catheter the latter is left out for a night to allow the fistula to contract a little. Similarly a self-retaining rubber catheter with rubber

flange and belt can be used. The urine is conducted to a rubber urinal attached to the thigh. The patient can get about and do his business without much trouble or leakage.

SUPRAPUBIC CYSTOTOMY

This operation may be required for exploration, drainage, the removal of stones, foreign bodies or growths from the bladder, for the treatment of ulceration of the bladder or for removal of the prostate.

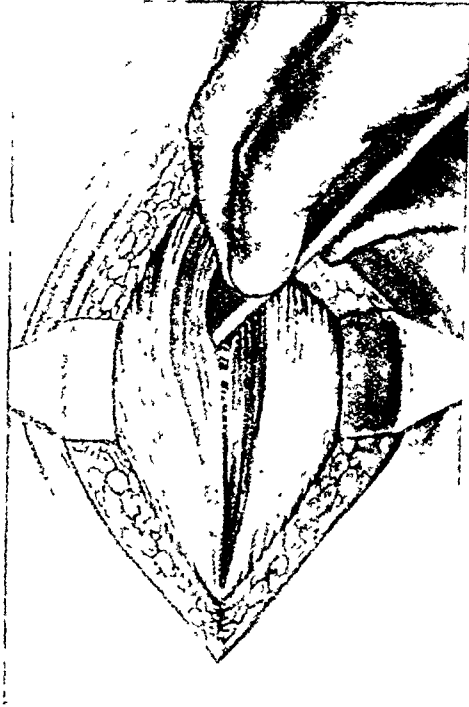


FIG. 307. Suprapubic cystotomy with patient in the Trendelenburg position. The recti are separated by blunt dissection.

Exploration *per se* is rarely necessary at the present time owing to the development and skilful use of the cystoscope.

(1) Severe cystitis especially in feeble old men and in the presence of obstruction of the urethra ; when the pain is intense and micturition taking place every few minutes with strangury, causing insomnia ; when there is high temperature and other evidence of imminent septicæmia ; when all other treatment has failed, and washing out is insufficient, unendurable or impossible.

The operation here, for the sake of the kidneys, must not be put off until too late. Much benefit may be obtained by irrigation and by the application of weak solutions of nitrate of silver.

When the cystitis is relieved and the patient is stronger, a suitable radical operation, such as prostatectomy, may be performed.

(2) As an aid to other operations. Thus before plastic operations

upon the urethra, to keep the parts dry and aseptic the bladder may be drained above the pubis

Operation When the patient is anaesthetised¹ a soft catheter is passed, unless the bladder is already distended from retention, the bladder is thoroughly washed out and filled with warm boric lotion or sterilised water until its outline can be seen or felt above the pubis. Either a tube and funnel or a bladder syringe of 8 oz capacity can be used. Usually about 12 oz of boric lotion can be retained without harm but when the bladder is small it is safer to defer the full distension until the suprapubic incision is made. Then the bladder projects into the wound as it is distended. The full syringe is left with its conical nozzle plugging the funnel end of the catheter ready for use if necessary. A vertical

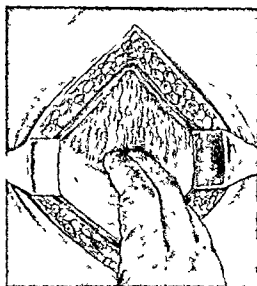


FIG 308 Suprapubic cystotomy. The peritoneum is separated and drawn upwards displaying the vascular bladder. The Trendelenburg position is adopted.

incision is made in the middle line extending upwards from the pubis one to four inches according to the object of the operation (Fig 307). The rectus sheath is opened, the muscle fibres are separated and the thin fascia transversalis is incised close to the pubis. With the left index finger the subperitoneal fat and peritoneum are displaced upwards out of the way until the bladder is displayed and recognised by its muscle fibres and large veins. The margins of the wound are protected with enveloping pads and the knife is plunged into the bladder about an inch above the pubis making a small vertical incision. As the knife is withdrawn and water rushes out, the left forefinger is introduced into the bladder to hold it forwards and plug the aperture while the liquid contents are allowed to escape through the catheter into a sterilised dish in order to avoid the mess so commonly seen at this operation (Fig 309). As the bladder

¹ Spinal anaesthesia is valuable when relaxation of muscle is essential. Local and regional anaesthesia are better for bad cases.

empties its whole interior and the upper part of the urethra can be examined. If it is necessary to do anything beyond draining the bladder the incision is enlarged to the required degree, mostly by stretching with the fingers in order to avoid bleeding. The margins of the vesical wound are held up with long mattress sutures. A stone or foreign body is extracted with scoop or forceps.

If it is necessary to see the whole interior of the bladder or to remove a new growth or ulcer from the lower part, the Trendelenburg position is always adopted, for the intestines gravitate towards the diaphragm and

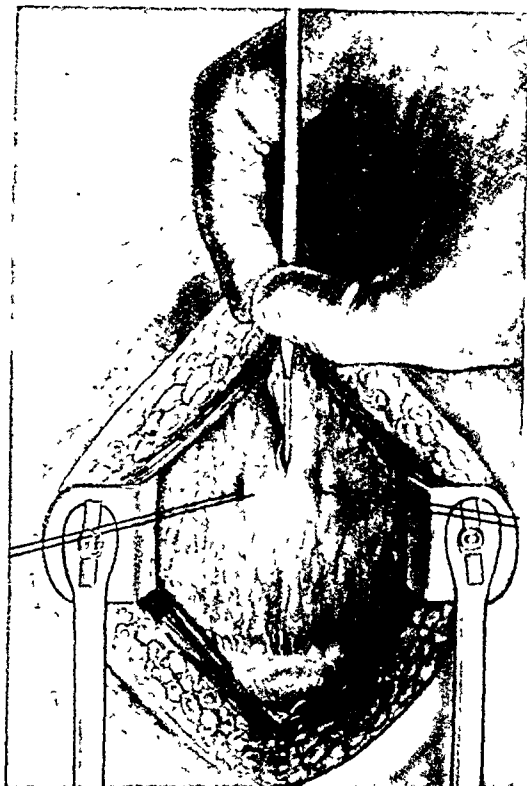


FIG. 309. Suprapubic cystotomy. Sutures holding up the bladder as it is incised.

the base of the bladder moves forwards and upwards, so that an infinitely better view is obtained. Occasionally it is necessary to cut across the lower fibres of one of the recti close to the pubis; this is better than to make use of the long transverse incision of Trendelenburg as a routine method, for the latter is often followed by ventral hernia. Good retractors and a forehead lamp now enable the surgeon to see all the mucous membrane after any blood-stained liquid has been mopped up with dry gauze. Towards the end of the operation the question of drainage will arise. If the urine be clean, the renal function good, and there be neither obstruction of the urethra nor bleeding going on within the bladder (*a*) the latter is completely closed with two continuous catgut sutures, which are threaded on curved round needles. The catgut should be of medium thickness

(No 1) and hardened to resist absorption for about three weeks. The deep suture pierces all the coats of the bladder, the reinforcing suture does not pierce the mucosa (see Figs 310 and 321). A small rubber tube is placed at the lower angle of the wound to drain the prevesical space for thirty six hours, the rest of the wound is closed in layers. A large soft catheter is tied in for four or five days, and washed through if it gets blocked with clot at any time.

(b) *Drainage is adopted* when there is considerable cystitis or oozing of blood or prostatectomy has been performed.

The simplest way is to introduce into the vesical wound a rubber tube¹ or self retaining catheter. If the tube is not gripped by the contracted

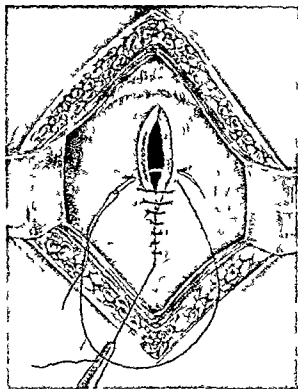


FIG. 310. Suprapubic cystotomy. The deep suture is shown. This is reinforced by a Cushing suture.

wall of the bladder, inverting sutures are inserted until the tube fits snugly. The parietal wound is closed around the tube, which is tied in position by a suture to the skin. The tube extends an inch into the interior of the bladder. To its outer end a long piece of rubber tubing is attached to conduct the urine into a receptacle under the bed. The prevesical space is drained by a small tube placed at the lower angle of the wound.

If necessary for bleeding or cystitis the bladder is washed out once or even twice a day at first with warm boracic lotion. For this a long rubber tube attached to a funnel or irrigating can holding three or four pints is

¹ The size of the tube varies with the amount of bleeding and the risk of retention of clots in the bladder. Usually a small tube or de Pezzer's self retaining catheter suffices.

used. The hydrostatic pressure is gradually increased. Unless prolonged drainage is required the tube is generally removed at the end of three days. The irrigating tube or catheter is then introduced through the suprapubic wound; and when this is impracticable the catheter is passed through the urethra if irrigation is still required.

Various methods of keeping the patient dry may be used, especially the Cathcart or White suction apparatus, or the Colt or Irving systems of collecting the urine as it issues above the pubis. The apparatus must be kept scrupulously clean and the cup must be made of metal so that it can be boiled every day. The wound, however, is more comfortable, keeps cleaner and heals better without any apparatus. It is simply dressed with antiseptic gauze. This is covered with a thin layer of sterile

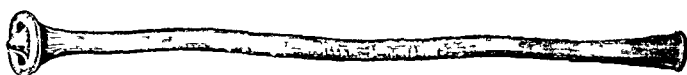


FIG. 311. Self-retaining catheter for suprapubic drainage.

cotton wool and large pads of cellulose wadding are arranged around the pelvis. If the fistula is slow in closing a catheter is tied in the urethra for a few days.

REMOVAL OF GROWTHS OF THE BLADDER

Chief Varieties.

(1) *Epithelial Tumours.*

- (a) Papilloma: (i) fimbriated papilloma or villous growth, often pedunculated; (ii) fibro-papilloma, which is sessile and almost smooth on the surface as seen with the naked eye.
- (b) Carcinoma: (a) villous or cauliflower variety; (b) flattened ulcerative and infiltrating variety.
- (c) Adenoma—a very rare growth.
- (d) Dermoids: (a) pigmented hairy patches, very rare with sebaceous and sweat glands; (b) dermoid cysts.

(2) *Connective Tissue Tumours.*

- (a) Fibroma.
- (b) Myxoma.
- (c) Sarcoma.
- (d) Myoma.
- (e) Angioma.

All connective tissue tumours are uncommon, but myxoma and sarcoma sometimes occur, especially in children. Phleboliths may form in a nævus, and these are very puzzling when shown by radiography.

By far the most common growths are (1) Simple villous papilloma; (2) Malignant villous papilloma; and (3) Carcinoma. These are found chiefly during middle age and are far more common in men. The large majority spring from the neighbourhood of the trigone, especially near the ureteral orifices.

All papillomata are potentially malignant, therefore the older the patient the more likely is the growth to be malignant. When the epithelium begins to invade the connective tissues of the bladder the

growth is becoming malignant, but it is not at all easy to tell, either with the naked eye the cystoscope or even with the microscope, whether any given villous tumour is innocent or malignant, for the one merges into the other without any sharp line of demarcation. Growths from neighbouring tissues may invade the bladder, especially from the prostate and rectum, and dermoid and hydatid cysts in the pelvis sometimes burst into the bladder.

Carcinoma springs from the lower zone of the bladder in 60 per cent, from the middle zone in 30 per cent and from the upper zone in 10 per cent (Fenwick). The most favourable carcinoma is the hard flat variety and the most favourable site for resection is the upper zone.

Practical Points in the Diagnosis Early and accurate diagnosis is here of the utmost importance.

(1) *Hæmorrhage* This is of much importance both in diagnosis and in its bearing upon an operation. Symptomless hæmaturia of vesical origin is very characteristic of growth of the bladder. Sir Henry Thompson laid much stress on the fact that in these cases the stream often begins without any or with little blood and ends a bright red colour. Pure blood may be expressed by the final efforts of the bladder as it closes upon and compresses the growth. Bleeding forms the initial symptom in a large number of cases especially when the growth is of the villous type. Mr. Hurry Fenwick¹ states that hæmaturia is the first sign in about 84 per cent of benign papillomata in about 75 per cent of villous carcinomata and about 60 per cent of the bald malignant growths.

In villous growth or fimbriated papilloma hæmorrhage alone may kill and it may be the only symptom throughout. In these growths the chief point is that the hæmorrhage is intermittent, extends over a long time,² occurs spontaneously and suddenly and without any allied symptoms and ceases in the same way the periods of intermission gradually become less till the bleeding is constant either rendering the patient utterly anæmic or adding to his misery by bringing about cystitis. These two last conditions may be so marked as to demand an operation. This symptom is most frequent in the villous growth (fimbriated papilloma) less so in the fibro papilloma or in the transitional 'growths'. In the flat carcinomatous or epitheliomatous growths hæmaturia is more frequently associated with other symptoms and it is less profuse but repeated small hæmorrhages with only short if any intermissions occur and exhaust the strength of the patient, and the blood is often dark from decomposition and is more diffused throughout the urine.

(2) *Sudden Arrest of the Stream of Urine* M. Guyon³ points out that in a few cases a pedunculated growth situated near the neck may cause obstruction and other troubles, before hæmorrhage appears.

Mr. Hurry Fenwick estimates that sudden arrest of the stream occurs as the initial symptom in about 8 per cent of the benign villous, and about

¹ *Tumours of the Urinary Bladder*

² Mr. R. Harrison (*Intern. Encycl. Surg.*, vi, 38) states that in the Museum of St. George's Hospital there is a specimen of a villous tumour attached to the neck of the bladder of a gentleman aged 81. The first attack of hæmorrhage had occurred twenty years before death and had lasted for eight months. An interval of four years had followed this and then a recurrence of hæmorrhage which ultimately proved fatal.

³ *Ann. de Val. des Org. Gén. Urin.*, 1889 p. 449

10 per cent. of the malignant villous growths : whereas it is very rarely noticed with the flat or bald variety of carcinoma.

Any tumour which grows quite near or infiltrates the tissues around the urethral orifice of the bladder may cause obstruction to the flow of urine sooner or later, and this may simulate carcinoma or even senile enlargement of the prostate. The writer removed suprapubically a villous growth which had prolapsed into the prostatic urethra, causing hæmorrhage with complete retention of urine. The growth was firmly gripped and gangrenous.

(3) *Unilateral Renal Pain.* Growths are so very frequently situated at or quite near to one or other ureteral orifice, that they often obstruct it either by dragging or compression from infiltration. Hence dilatation of the ureter and renal pelvis or pyelitis may develop and cause pain in the corresponding loin.

This may be the initial symptom of vesical growth occasionally, and the kidney has been needlessly explored in some cases under these circumstances. This symptom, which may serve to locate the growth, is noticed earlier with benign papilloma than with villous carcinoma, which obstructs by infiltration around the ureteral end.

(4) *Frequency of Micturition* and other symptoms of vesical irritation are most frequently associated with the infiltrating flat growths, and they are least common with benign villous tumours. Fenwick estimates that these symptoms are the initial ones in about 30 per cent. of the bald carcinomata, 15 per cent. of the villous carcinomata and only 8 per cent. of the simple villous papillomata. Pain is more frequent and most severe with infiltrating carcinoma.

(5) *Examination of the Urine.* Careful examination of the urine should be frequently made, and the patients directed to bring, at once, any white or shreddy particles passed. The delicate papillæ, with their connective-tissue basis supporting hosts of columnar cells with large delicate capillaries, are most characteristic. Recognisable fragments are more rarely cast off the malignant villous growths, and when any are found they give no indication of the nature of the base of the tumour ; the villi may be innocent in appearance, and yet the base may be malignant. It is uncommon for the bald or flat growths to shed any pieces until the late sloughy stage, but, when seen microscopically, the fragments are characteristic enough. It is very important to estimate the renal function, for if this is seriously lowered no operation should be undertaken on account of the danger of death from uræmia. Wasting is very characteristic of malignant disease of the bladder.

(6) *Rectal Examination.* This should never be omitted for, with the bladder empty of urine, the finger may detect a thickening, hardness or rigidity of the base above the prostate, indicating an infiltrating growth. Usually the mass is separate from the prostate, but in late cases the latter may not be distinct from the growth. A benign growth cannot be felt per rectum, and the villous carcinoma may only indicate its presence by an unusual fulness or heaviness of the bladder, but a carcinoma which infiltrates the vesical wall soon becomes palpable, and Fenwick states that quite 50 per cent. of these growths are palpable per rectum, within a year of their origin. A rectal examination may thus enable the surgeon to dispense with cystoscopic or other examina-

tions of the interior of the bladder, for in late cases an operation is futile, and a mere cystoscopic examination is not free of danger in them. The patient should be examined in the kneeling attitude as well as in the supine position, for the former posture enables the surgeon to feel higher up the posterior wall of the bladder. Bimanual examination with the patient supine, and the abdominal wall relaxed, may discover infiltrating growths placed in unusual positions such as at the fundus or on the anterior wall. In the female, vaginal examination should be conducted in a similar way.

It is unnecessary and unjustifiable to sound any patient suffering from hæmaturia only, for a stone is extremely unlikely to be the cause.

(7) *The Cystoscope*—In skilful hands the cystoscope is of the greatest value in the detection and examination of vesical growths. It enables the surgeon to define the nature, size, number, position and character of the basal attachment of the growths, and also the presence or absence of infiltration of the vesical wall.

The knowledge gained through the cystoscope may indicate the exact nature and degree of surgical interference, if any, that may be required, so that the surgeon can adopt the most suitable method without waste of time during the actual operation. It is imperative to conduct the examination aseptically, and with all gentleness so that neither cystitis nor hæmorrhage follow.

(8) *Exclusion of other Conditions*—Bacilluria, tuberculous and other forms of cystitis, also hæmorrhage from the prostate or kidney. In none of these, save the last, is there the spontaneous character which often marks the bleeding of bladder growths. In renal hæmaturia due to growth the bleeding may be spontaneous and unaccompanied by other evidence. Here the renal regions should be thoroughly examined at regular intervals, but the cystoscope may show blood issuing from one ureter. In tubercular disease of the bladder the bleeding is never as severe as in growth, and for a long time occurs only at the end of micturition. Other evidence will also be present and so too, with the hæmorrhage of enlarged prostate which will very likely be associated with some residual urine.

Indications for Operation. Growths of the bladder being nearly always fatal sooner or later, whether from hæmorrhage, pain or the results of obstruction or from these combined, the surgeon should urge an early cystoscopic examination to clear up the diagnosis and to decide the question of removal. If cystoscopy¹ demonstrates one or more papillomata of innocent type fulguration should be tried, for it has been very effective. This must be followed by cystoscopic examination every three months, so that the treatment can be repeated directly any recurrence appears. This method is not suitable for malignant or doubtful growths, which should be removed without delay whenever possible.

If in doubt as to recommending operation, the surgeon should remember—(1) that the long intervals between the bleedings teach strongly that growths of the bladder often pass through a long first stage, during which the growth is connected with the mucous membrane only, (2) that, following on the above, infiltration of the deeper coats and dis-

¹ *Beer Journ Amer Med Assoc*, 1910 iv, 1763, *Keyes Trans Amer Assoc of Genito-Urinary Surg*, 1910 v, 193, and *W Girling Ball, Brit Journ Surg*, 1921 xi 760

semination is often here long delayed. While the long intervals between the bleedings and the comparative slightness of the other symptoms may make the surgeon unwilling to urge operative interference, it is right that it should be very clearly put before the patient that it is in this stage only that any hope of a radical cure can be given, and that later on, when the stage of infiltration is reached, not only is radical cure almost out of the question, but the risk of attempting it is vastly increased. A careful chart of bladder growths should be made and kept as a record. The more the growth approximates to the worst of all types of bladder growth—viz. the low-lying, broad-based, large, fixed, sessile lump, especially if with a sloughy surface encrusted with phosphatic débris, the more hopeless is operative interference. Invasion of the whole trigone, both ureteral orifices or urethra contra-indicates operation. If the renal function is seriously impaired, the general health poor, or if there is any sign of metastases or very extensive local infiltration palpable from the rectum or vagina, no operation should be undertaken, except for drainage as a palliative measure in some cases of obstruction of the urethra.

OPERATIVE TREATMENT

Operations for growth of the bladder may be either radical or palliative, and the exact nature of the operation, if any, is decided after a careful cystoscopic examination. Palliative operations are performed for irremovable growths. The urine is drained away above the pubis or by bringing the ureters to the skin or colon.

Radical operations may be undertaken by :

- (1) Suprapubic cystotomy.
- (2) Transperitoneal cystotomy.

(1) SUPRAPUBIC CYSTOTOMY FOR REMOVAL OF GROWTH

This is the best method to adopt for the large majority of cases ; for it gives plenty of room with good and safe drainage after the operation. For some high malignant growths it is necessary to continue the wound into the peritoneum, and to remove the whole thickness of the vesical wall including its peritoneal coat, but even then the peritoneum can be completely closed and extraperitoneal suprapubic drainage safely adopted.

But about 85 per cent. of vesical growths are at the base and can be widely resected, and if necessary the ureters can be transplanted, without opening the peritoneum. This is surely an advantage, for the urine is often infective. Free drainage is generally required on this account and because of the difficulty of completely arresting hæmorrhage. The urethral drainage adopted with the transperitoneal cystotomy is not always adequate after the removal of growths of the bladder. When free exposure is required, there is no great advantage in opening the peritoneum, for it does not give appreciably more room. It is not the peritoneum but the recti abdominis which offer the greatest hindrance to the due exposure of vesical tumours. The peritoneum can be separated and pushed up out of the way unless the growth invades the wall of the upper part of the bladder. It acts as a good retainer and protector of the small intestines, and is, in fact, of value in assisting the Trendelenburg position.

The recti can be relaxed by good anaesthesia and drawn aside by suitable retractors. The full Trendelenburg position and a forehead lamp are invaluable aids.

The details of the exploratory incision have been described at p. 601. It is often necessary to divide the fibres of one rectus about one inch above the pubis in order to get a proper view of the lower part of the

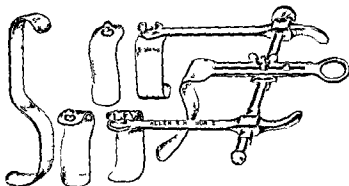


FIG. 312 Thomson Walker bladder retractors

corresponding side of the bladder. The bladder having been opened to the necessary extent the edges of the opening are secured to the rectus sheath by temporary mattress sutures which pierce all the coats.

Large thin enveloping pads are applied to protect the edges of the parietal and vesical wound and suitable retractors are introduced. Those designed by Thomson Walker¹ are good for they separate the recti and push out the lateral vesical walls at the same time.

THE REMOVAL OF PAPILLOMATA

The interior of the bladder having been well displayed and carefully examined the number, size and position of the growths are noted and, later recorded. Sir J. Thomson Walker recommends that a gauze swab, soaked in 4 per cent. solution of nitrate of silver be placed over the



FIG. 313 Thomson Walker bladder needle

growths for several minutes to cause superficial necrosis and thus prevent infection of the wound. Any excess of the solution is mopped up. The mucous membrane near the growth is picked up with two long fine toothed forceps and divided between them with long curved scissors. An oval or circular piece of mucosa bearing the papilloma is then raised with one pair of forceps from the muscular wall of the bladder and gradually cut away with scissors. The wound is closed accurately with a fine catgut continuous suture which also stops all the bleeding. Thomson Walker's long handled small curved flexible needle is very useful for this purpose.

¹ *Lancet* March 5 1910

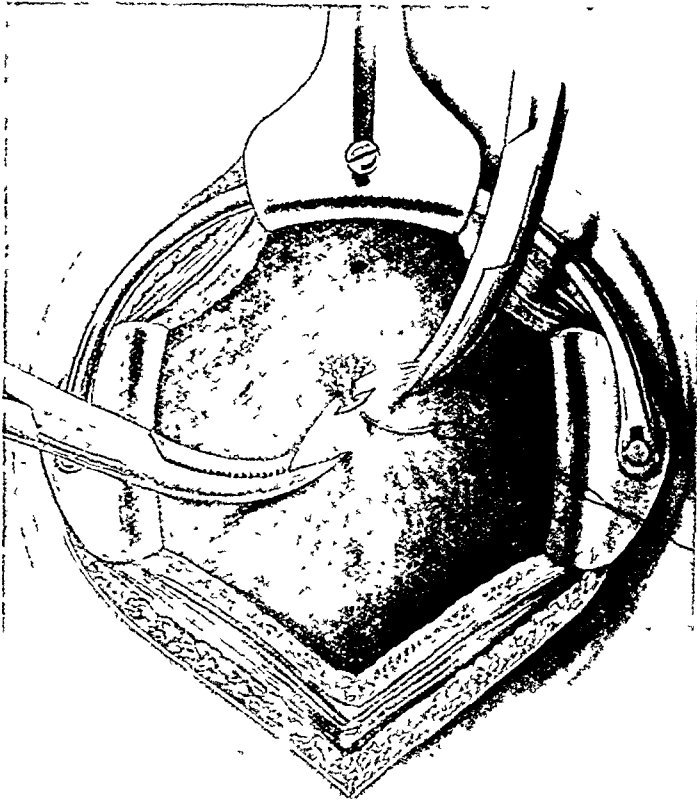


FIG. 314. Excision of vesical papilloma. The mucosa is picked up near the growth, the base of the latter is excised and the wound is sewn with fine catgut.

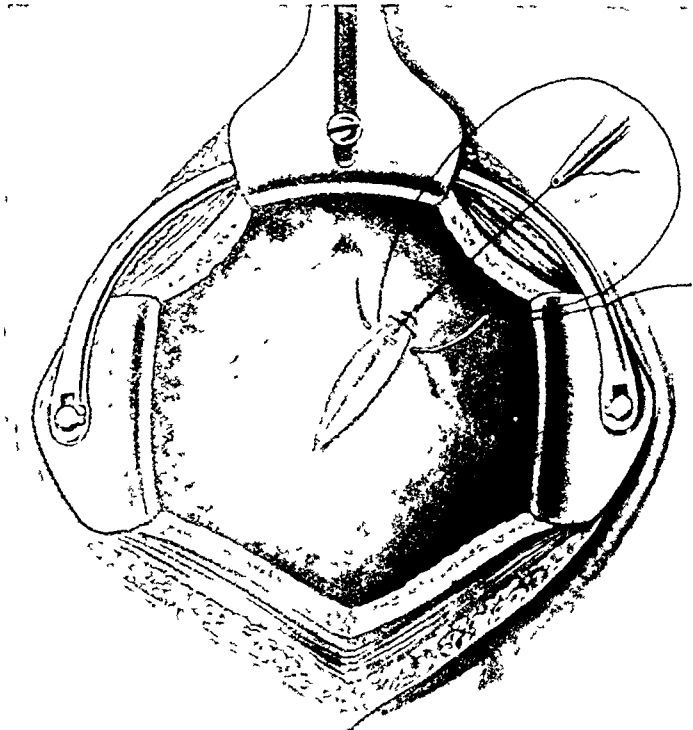


FIG. 315. Excision of vesical papilloma. The wound at the base is closed with a continuous catgut suture.

Each papilloma is excised in a similar way care being taken to prevent implantation of any of the cells of the growth by contact with any of the vesical wounds. Soiled instruments are discarded for the same reason and the mucosa is swabbed with 4 per cent silver nitrate solution and dried before the bladder is closed as already described. A small drainage tube is usually placed at the lower angle of the wound in the bladder but when all bleeding has been arrested the bladder can be completely closed and

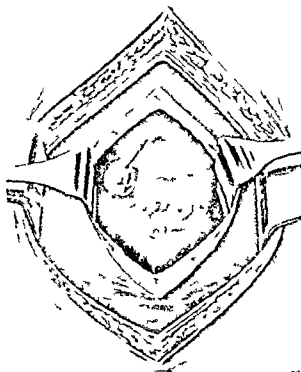


FIG. 316. Carcinoma at left ureteral orifice with little of the ureter

drained through the urethra the prevesical space only being drained by a small tube.

PARTIAL EXTRAPERITONEAL RESECTION OF THE BLADDER FOR MALIGNANT GROWTHS

The bladder is opened and examined as already described (p. 601).

When it is doubtful whether a growth is innocent or malignant the following test of Albarran may be useful. The gliding or otherwise of the mucous membrane ought to regulate the depth of the removal of the growth. Whenever the mucous membrane seems fixed to the submucous coat it would be better even in pedunculated growths to resect the entire thickness of the wall—a step still more essential in small sessile tumours. When still in doubt it is better to regard the growth as malignant and to remove it together with a good margin around it of the entire thickness of the bladder wall. Whenever possible at least an inch of apparently

healthy tissue around the growth is removed, care being taken to save the valuable valvular ureteral ends by keeping at least a third of an inch away from their orifices. Unfortunately the large majority of vesical growths occur at or near the trigone. When it is necessary to remove a portion of one ureter the latter may be implanted in the reconstructed bladder; and in some cases both ureters may be so treated.

The growth can be most readily resected when situated somewhere in the upper or middle zones of the bladder, whereas it may be very difficult or even impossible to excise widely enough when it grows at the trigone,

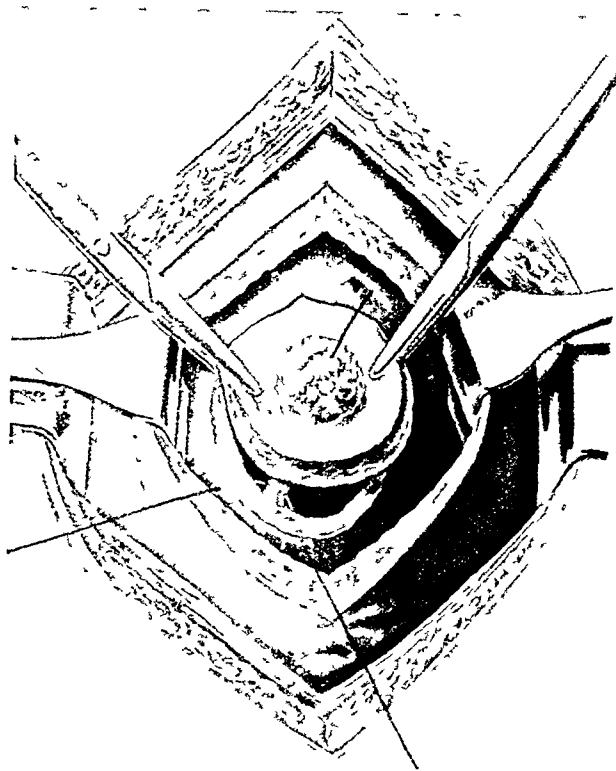


FIG. 317. Excision of carcinoma at left ureteral orifice. The whole thickness of the bladder wall has been isolated around the growth, and the ureter isolated and transfixed by a catgut suture, which also pierces the bladder wall near the upper end of the incision.

without removing one or more ureteral orifices or trespassing on the prostatic urethra; but the latter and the prostate can be removed without incontinence.

When the ureter is sewn as above to the upper angle of the posterior wound and care is taken not to constrict it by suture, there is little fear of stenosis of the orifice, less in fact than if the ureter is transplanted by drawing it obliquely through the bladder wall. Moreover, the method recommended is much simpler and speedier. When the space behind the bladder and below the peritoneum needs drainage, a rubber tube is carried from it just below the ureter out through the suprapubic wound. When the tube is withdrawn its track contracts and tends to dilate the ureteral orifice as shown by Thomson-Walker.

It is not absolutely necessary to sew the ureter to the angle of the posterior wound in the bladder for when a good length has required removal it has been simply cut across and abandoned in the subperitoneal tissues behind the bladder with a drainage tube placed just below it and passing through the bladder out of the suprapubic wound. Albarran, Walker¹ and Pilcher have adopted this method.

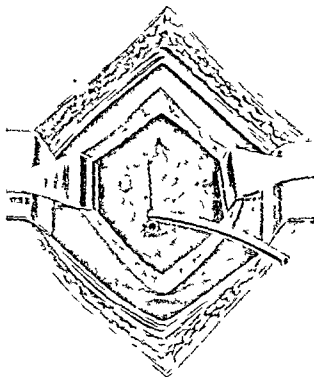


FIG. 318. Fixation of carcinoma at left ureteral orifice. The ureter has been sewn at the upper angle of the incision and a tube inserted just below it to drain the cavity behind the bladder.

In his case Thomson Walker, on cystoscopic examination three months later, saw a funnel shaped ureteral orifice.

(2) TRANSPERITONEAL REMOVAL OF GROWTHS OF THE BLADDER

Harrington² was the first deliberately to open the bladder through the peritoneum for the treatment of an ulcer at the base. Later C. H. Mayo³, Scudder and Davis⁴, Judd⁵, Tennant⁶ and Pringle⁷ strongly

¹ *Proc. Roy. Soc. Med.* January 1910.

² *Ann. Surg.* 1893 xviii 408.

³ *Ibid.* July 1909.

⁴ *Ibid.* December 1908.

⁵ *Journ. Amer. Med. Ass.* December 20 1909.

⁶ *Ann. of Surg.* 1910 p. 657.

⁷ *Lancet* 1911 i 214.

advocated this method for the removal of bladder growths. They say it gives more room and greater facilities for the removal of growths low down in the bladder, thus allowing more radical operations to be performed. A transperitoneal wound of the bladder, when properly sewn, is not so likely to leak as the ordinary suprapubic extraperitoneal wound on account of the greater adhesive powers of the peritoneum, so that this method ensures a *quicker recovery when drainage of the bladder is not*

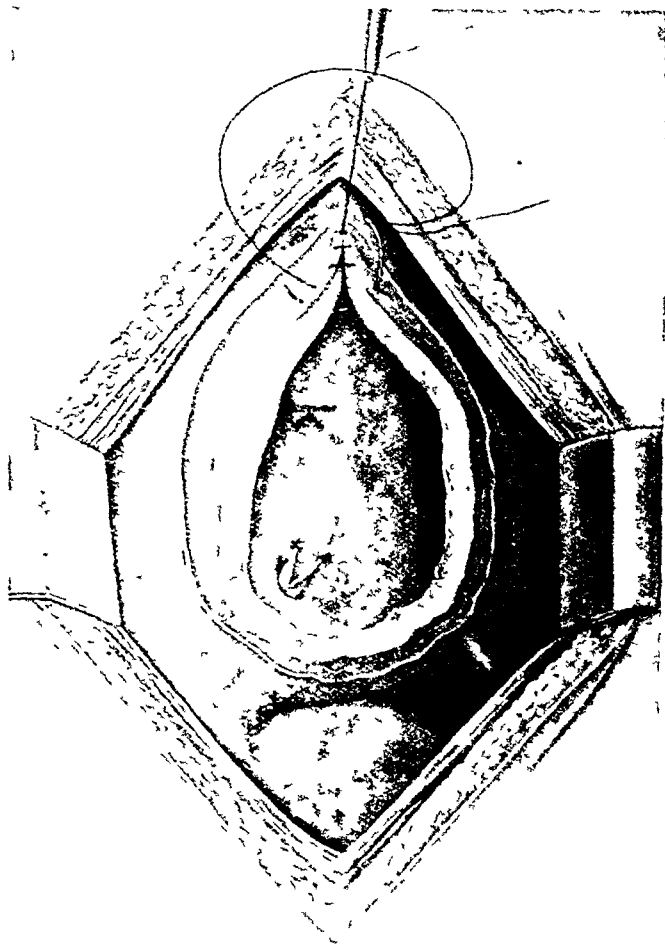


FIG 319 Transperitoneal excision of a large piece of the bladder, the left ureter has been implanted in the remainder of the bladder.

required. Moreover, the abdominal incision enables the surgeon to explore the abdomen thoroughly, and this may be valuable. Although infection of the lymph glands and dissemination of bladder growths is uncommon and late, yet Judd found an early secondary growth in the liver in one case and infection of the pelvic peritoneum in another. It is also maintained that by this method it is easier to protect and prevent infection of the parietal incision and vesical wall. The prevesical space is difficult to protect with the ordinary suprapubic extraperitoneal operation.

I agree with Thomson Walker that the chief difficulty in exposing vesical growths is not the peritoneum which can be easily stripped off the bladder and displaced upwards but the rigidity of the recti abdominis. Therefore I take care to make the vertical incision of an adequate length and relax the muscles by good anæsthesia flexing the thighs and if necessary I divide the fibres of one or both recti. But I never hesitate to adopt the peritoneal route when the cystoscopic examination indicates the need of removing a part of the bladder covered by peritoneum nor do

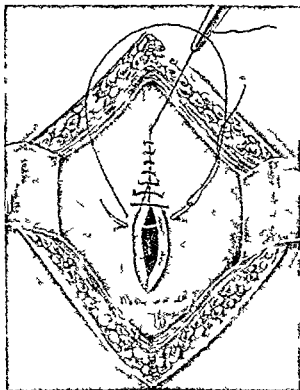


FIG. 390. Transperitoneal excision of growth of the bladder. The wound is closed with a continuous catgut suture which pierces all the coats.

I hesitate to open the peritoneum when the need is demonstrated by the ordinary suprapubic exploration.

It is often necessary to do this in order to resect a malignant growth at the upper and back part of the bladder more often I think than to deal with the majority of innocent or malignant growths at the base. It must not be forgotten that this route carries with it a considerable risk of infection of the peritoneum.

Operation. The bladder having been washed out and emptied immediately before the operation the high Trendelenburg position is adopted and a median incision extending upwards from the pubis for at least six inches, is made. The intestines are protected and kept out of the way by large gauze packs. The abdominal wound is also protected with enfolding gauze pads kept in position by suitable retractors. The bladder is then drawn up by two long forceps on either side of the fundus and a median incision two inches long is made. All urine is gently mopped

away and the bladder is examined. If necessary the wound is enlarged. A pedunculated tumour is held up with forceps while its base is transfixed and tied with fine catgut. A sessile tumour is held up with forceps and removed with curved scissors, the resulting wound being either sewn with catgut or cauterised with the thermo-cautery, until all bleeding is arrested, or the tumour may be separated with the thermo-cautery. In any case, some of the healthy mucous membrane must be removed. With a malignant tumour, especially of the infiltrating type, the whole thickness of the bladder wall must be removed, and if possible a margin of at least one inch of healthy tissue must be taken away all round the growth. It

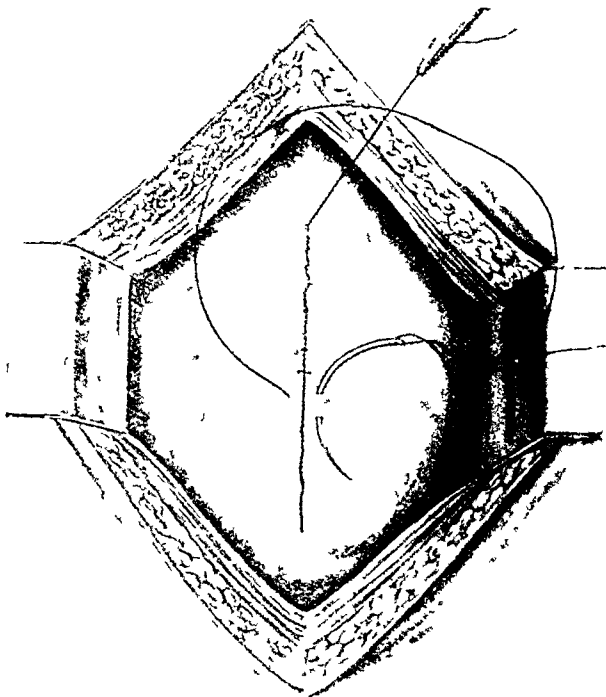


FIG 321 Transperitoneal excision of growth of the bladder. A Cushing serous suture is used to invaginate the deep suture.

is important not to trespass upon the urethral orifice, and no interference with the function of this important part will take place if the wound does not reach within one-third to half an inch of it. In many cases one or both ureteral orifices may be involved in the growth. When only one is affected an elliptical piece of the bladder around the orifice is isolated, and drawn upwards, and the ureter is separated by gauze dissection until a healthy part is reached well above the growth. At this spot the ureter is transfixed with a catgut suture and divided in front of the suture. The growth, which is now free, is removed and the ureter is anastomosed to the bladder in one of two ways. (a) It is sewn to the upper angle of the posterior incision in the bladder as already described at p. 612. (b) If a large amount of the bladder has had to be removed the ureter is drawn subperitoneally towards the remainder of the bladder, and obliquely

through the vesical wall and secured to the mucous membrane by a couple of catgut sutures. If the ureter has traversed any of the peritoneal cavity, the exposed part is covered by sewing folds of the adjacent peritoneum over it. The incision in the posterior wall of the bladder is carefully arrested in this way. Then the exploring vesical wound is accurately sewn with a continuous Connell suture of catgut which as usual pierces all the coats, inverts the edges and arrests hæmorrhage. This is reinforced by a continuous

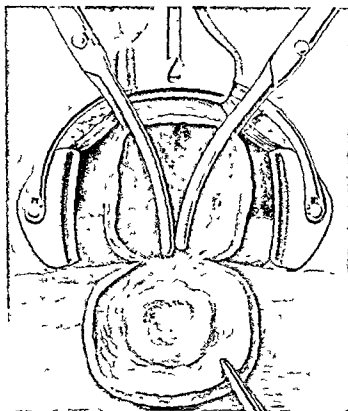


FIG. 322. Excision of flat epithelioma from upper part of bladder. The clamps control the hæmorrhage. The bladder is reconstructed by continuous catgut piercing and continuous Lembert sutures.

Cushing suture of fine catgut. If for any reason it is necessary to drain the bladder, a tube is introduced through a separate suprapubic puncture. The tube is inserted before the upper wound in the bladder is closed. As a rule no drainage is adopted either of the peritoneum or of the bladder, and no catheter is used. The patient passes urine fairly frequently at first, and if there be much discomfort or bleeding develop it is well to wash out the bladder several times with boracic solution. In some cases a large rubber catheter is tied in.

Judd records fifteen transperitoneal operations for the removal of bladder tumours, at the Mayo Clinic, with only one death, and that was from uræmia in an old man who had severe hydronephrosis on one side.

It is probable that free drainage would give such a patient a better chance of avoiding uræmia, judging by the great value and absolute need of drainage after prostatectomy in feeble old men. Six patients were alive and without evidence of recurrence over a year after the operation. One with a malignant papilloma had a similar tumour removed from the opposite side of her bladder eighteen months later. Sufficient time had not elapsed in most of the others for any valuable conclusion to be made as regards the question of recurrence.

It has not yet been demonstrated that the transperitoneal route confers a greater freedom from recurrence than the suprapubic method. This depends much more upon the actual technique and extent of the removal.

The Removal of Vesical Growths in Women. Suprapubic cystotomy is not necessary for the removal of pedunculated benign growths from the female bladder, for these can be removed through the dilated urethra with less risk, and with little, if any, more chance of recurrence. Malignant and sessile growths must be removed suprapubically, as in the male. When the surgeon has decided to remove a growth through the urethra, the bladder is washed out, and the urethra is dilated with Kelly's conical dilators. A large Kelly's speculum is then introduced, the growth is sought, brought into view and removed as described above (p. 609).

RESULTS OF REMOVAL OF BLADDER GROWTHS

Dr. F. S. Watson¹ in a valuable paper gives the results of his careful analysis of the records of 653 operations for various growths of the bladder. This number includes the cases published by Albarran in 1892, and others collected or observed by Watson since that time; 243 of the operations were for benign and 410 for malignant growths. From this study Watson concludes that "the sum and substance of the result of operative interference up to the present time may be stated thus: If the operative deaths and rapid recurrences are combined under the one heading of operative failures, such failures are seen to have occurred in the 28·6 per cent. of the benign tumours, exclusive of myxoma, and in 40 per cent. of the cases of carcinoma."

Watson's collected cases included 17 partial resections for papilloma, with 1 death, 4 for myoma, with 1 death, making a total of 21 partial resections for innocent growths, with 2 deaths, a mortality of 9·5 per cent.

For carcinoma there were 91 of these operations, with 17 deaths—a mortality of 18·6 per cent. It is interesting that this death-rate was less than that for the 222 suprapubic operations without resections, for the latter were attended by a mortality of 28 per cent.

There was a freedom from recurrence for over a year in 37·5 of the cases of papilloma, as compared with an immunity for over a year in only 27·5 per cent. after suprapubic operations without resection. It is hardly necessary to mention that recurrence often takes place after a year.²

"The very large percentage of recurrence seems to point logically to

¹ *Ann. of Surg.*, 1905, xlii, 805.

² In the practice of brilliant individual surgeons the results are much better. Thus Fenwick has a mortality of 2 per cent. from villous papilloma and only 7 per cent. for carcinoma, and recurrence in only 16 per cent. of villous papillomata.

the necessity of more radical measures in benign as well as in cases of malignant tumours if we are to hope for better results."

CYSTECTOMY

Complete cystectomy has been performed by Bardenheuer and Gussenbauer. The first successful case was by Pawlik of Prague. The operation was done in two stages the ureters being first diverted to and secured in the vagina and about three weeks later the bladder removed. The vagina by the second operation was converted into a false bladder the urine being voided through the urethra. Pawlik's patient was well sixteen years after the operation. Tuffier and Dujarier¹ described a successful case of complete extirpation of the bladder in a man in one operation the ends of the ureters being implanted into the rectum. Two months after the operation the man was able to do his work.

Indications. The entire removal of the bladder is an operation which is very rarely justifiable and must not be lightly undertaken for it leaves the patient with permanent urinary fistulae which are very troublesome. It is true that with transplantation of the ureters into the bowel the sphincter can provide a fair control of the urine but the dangers of ascending nephritis are so great that most authorities have advised against this method. Moreover extirpation of the bladder is a difficult operation which carries a mortality of about 50 per cent.

(1) Malignant growth is the chief indication especially when the disease is so extensive or unfortunately placed that its free removal destroys all hope of a continent bladder. When a malignant growth infiltrates the bladder wall extensively at the base there is little hope of eradication of the disease without cystectomy. Soft rapidly growing carcinoma especially if recurrent and extensive calls for cystectomy but this operation is contra-indicated in late cases when the bladder has become adherent to neighbouring structures or when lymphatic infection or dissemination has taken place. Fortunately the disease is confined to the bladder for a long time in the majority of cases and kills by obstruction of the ureters with ascending nephritis and exhaustion from pain hæmorrhage sleeplessness and chronic uræmia. To be successful the operation must be undertaken before the patient's health is undermined.

(2) Very extensive papillomata. Watson² and H. Fenwick³ have suggested that cystectomy should be performed for troublesome cases of this condition but fulguration has made the operation unnecessary.

(3) The operation has been performed for severe and late tuberculous ulceration with contraction of the bladder frequent micturition and sleeplessness but it is not to be recommended for this condition.

(4) Some cases of ectopia vesicæ.

Preliminary Ureterostomy. To divert the urine and improve the condition and function of the kidneys and thus make cystectomy safer easier and speedier, Watson strongly advocated preliminary nephrostomy. Rosving suggested and Fenwick adopted⁴ ureterostomy with the same object in view. Fenwick found it better to bring the ureters out in front

¹ *Revue de Chirurgie*, April 1908.

² *Loc. supra cit.*

³ *Brit Med Journ.*, 1908, ii, 93.

⁴ *Brit Med Journ.*, June 1904.

for the dressing and care of the fistulæ is easier than when the lumbar route is adopted. He also tied the upper vesical arteries at the same time. Rosving has brought the ureters out through the triangle of Petit.

The ureters have been diverted into the rectum, vagina or urethra, but the general opinion is in favour of bringing them to the skin, except in some cases in women where the vagina is suitable and very convenient for the preliminary ureterostomy as in Pawlik's case. Transplanting them into the rectum is almost certain to be followed sooner or later by ascending suppurative nephritis, and in most cases the transplantation has not been completely successful, some or all the urine escaping through cutaneous fistulæ.

Wherever the ureters are diverted there is a great liability to stricture of the orifices with interference with the renal function and ascending nephritis, so that great care must be taken to make and maintain satisfactory openings.

Coffey has carried the ureters for some distance in the submucosa of the colon before they pierce the mucosa, thus imitating their natural valvular entrance into the bladder. He ties catheters into the ureters and leads these through the rectum and out at the anus. In this way he avoids both obstruction and undue patency of the ureters with ascending nephritis. He implants both ureters at the same time.

Suprapubic Cystectomy. As a rule this should be performed at least a month after preliminary biureterostomy. When the growth has not invaded the peritoneal coat of the bladder it may be possible to perform cystectomy extraperitoneally, but when the operation is indicated at all it is better to open the peritoneum so that the liver, lymph glands, pelvic peritoneum and the extent of the growth can be examined before finally deciding upon the operation. The recorded cases show the wisdom of this step, for in four of the immediate fatalities secondary growths were discovered after death, and it is probable that some of the many deaths within a year of the operation were due to secondary growths not discovered at the operation. Moreover, this step makes the operation easier and speedier. With careful packing, and the Trendelenburg position, the risk of peritonitis is small, especially when the bladder is not opened during the operation. When cystectomy is indicated the growth is usually infiltrating and basal, therefore its extirpation demands the removal of the prostate, and this makes the operation somewhat easier and the risk of hæmorrhage less, for it leaves only the urethra to be tied.

The question of opening the bladder during the operation is an important one. Even with preliminary ureterostomy and irrigation of the bladder, the contents of the latter are more or less septic, so that it is desirable to remove the bladder entire and unopened. This is the ideal which is attainable with careful and reliable cystoscopic examination, but when there remain doubts as to the need of cystectomy, the bladder must be explored and carefully examined before embarking on such a serious operation. For the same reason preliminary ureterostomy must not be performed without certain knowledge that the bladder cannot be reconstructed after the growth has been well removed.

Fenwick described his method as follows :

“ The technique of excision of the bladder is simple *if the viscus is not*

adherent Its secret consists in the operator using a strong electric head lamp appropriate retractors and in shelling out the *distended* bladder without opening it except at the vesical orifice by keeping strictly to the outer muscular layer of the organ. A vertical skin and a transverse muscle incision are made suprapubically. The bladder being brought into view the posterior aspect is first separated by scissor clipping from the peritoneal layer as far down as the posterior border of the prostate. The separation proceeds *between the prostate and the bladder* base until the trigone is reached. If there is any suspicion of cancer the vesicles and prostate must be removed also and in this case the shielding hand protects them from the rectum while the scissoring continues. The anterior surface is now separated from the pubes as low as the prostate.¹ With a little tactile dexterity the scissors (a broad bladed pair) can be made to cut cleanly through the vesical orifice—if the prostate may be left—and the trigone. The freed bladder is now lifted on to one side to allow of the ureters being traced these are detached a little way up and divided. If the prostate has to be ablated the scissors aim lower and cuts through the membranous urethra to join the posterior incision.

If the posterior upper wall is invaded and the peritoneum involved this must be taken freely away and flaps of peritoneum brought up from adjacent areas.

Excision of the bladder for cancer is not one that a novice in surgery had better undertake. It often entails much patience and great skill to avoid tearing open vessels and bowel. Moreover a false diagnosis of cancer of the bladder and excision on a false premise would bring unthinkable discredit on surgery and untold misery to the patient.

Cystectomy by the Combined Suprapubic and Perineal Method (Kuster) There is rarely any need for the perineal wound which adds to the length of the operation without conferring any material advantage.

First the prostate and bladder base are separated from the rectum through a transverse perineal incision and then the suprapubic separation of the bladder is carried out. For the same reason symphysiotomy is not to be recommended for although it gives good access the time consumed in wiring is a great disadvantage. Moreover the wound is liable to infection so that the wire may need removal afterwards.

Results of Cystectomy The *mortality* of cystectomy has been high partly on account of the magnitude of the operation but chiefly due to its adoption as a forlorn hope in very late cases where the growth is very extensive or infection of the lymphatic glands or even dissemination has occurred. The condition of the kidneys as a result of long continued backward pressure and ascending infection has been very bad in a number of cases.

Dr Watson² has collected the records of 25 cases of total extirpation of the bladder for carcinoma with 14 deaths a mortality of 56 per cent out of the 11 that recovered 6 or 54.5 per cent were known to be free of recurrence a year later.

Later Thomson Walker³ found the immediate mortality in the 39 recorded cases to be 46 per cent.

¹ At this stage the bladder should be emptied with a catheter.

² *Ann of Surg* 1900 xl 803.

³ *Burghard's System of Operative Surg* 1 473.

Rosving¹ reported three cases before the German Association of Surgeons—one, a man aged 67, died eight days after the operation; one, a man aged 30, was alive and well eleven months after the operation; and the third, a man of 57, had survived the operation a month at the time of the report. Fenwick has recorded three successful cases.

The *ultimate results* have been poor, for recurrence has been early in many cases and in the others either obstruction of the ureters or ascending nephritis has ensued; but Schule² states that 32 out of 62 patients operated upon for malignant disease were "cured."

Very few have survived over five years.

OPERATIONS FOR STONE IN THE BLADDER

CHOICE OF OPERATION. LITHOLAPAXY OR LITHOTOMY

(1) **The most desirable operation.** Granted that the surgeon is equally skilful in litholapaxy and lithotomy, the former in suitable cases (which make a large majority) is the more desirable operation, for with it (a) the risk to life is less; (b) the amount of pain and inconvenience is much less, and (c) the recovery is much more rapid.

(2) **Amount of experience of the surgeon.** No surgeon who has not seized abundant opportunities of practising the needful manipulations will act wisely in attempting to crush a large, hard stone; he will get a better result from suprapubic lithotomy in difficult and bad cases.

(3) **Size, kind and number of stones.** As to size, if the short axis of the stone is not over $1\frac{1}{2}$ inches it can be grasped by the lithotrite. In practised hands litholapaxy is immensely superior to lithotomy, and very large stones may be successfully crushed by an experienced operator with specially strong instruments. Sir P. J. Freyer³ crushed one weighing $14\frac{1}{2}$ ounces and Mr. H. Milton⁴ one of urates and phosphates weighing 12 ounces. The operation lasted two hours and a special lithotrite with a gape of 5 inches was used.

To any one with very limited experience rashly contemplating an attack upon a hard stone I would recall Mr. Milton's words: ⁵ "During the first twenty minutes of a long crushing most men can maintain the necessary delicacy of manipulation, combined with the exercise of considerable force; but when it comes to working at the same strain for a second, third or fourth, or even fifth, sixth or seventh period condition begins to tell . . . this force has to be exerted with the greatest discrimination and the greatest patience."

More important than the size of the stone is its composition. There is, of course, no comparison between a pure lithic acid or oxalate of lime stone on the one hand and an alternating stone with a good deal of phosphate or urates in its composition, as a test of skill and endurance both on the part of the surgeon and his instruments.

Cystoscopic and X-ray examinations give the most reliable evidence as to the size, number, position, and composition of vesical calculi.

¹ *Zeit. F. Chir.*, 1907, xxi, 94.

² *Carson's Modern Operative Surgery*, ii, 668.

³ *Surgical Diseases of the Urinary Organs*, 1908, p. 335.

⁴ "Lithotrity, Simple and Complicated," *Lancet*, April and May, 1896.

⁵ *Loc. supra cit.*

Very large or multiple stones, especially if dense and hard, are best treated by suprapubic lithotomy

(4) *Condition of the urethra.* It is necessary to ascertain, by means of suitable sounds or large catheters, if the urethra will admit the lithotrite. A stricture, if admitting of dilatation or internal urethrotomy, is not a serious obstacle to litholapaxy, on the other hand, an old stricture with surrounding induration and fistulae, and a less severe form which produces rigors and fever at each attempt of dilatation are best submitted to lithotomy, which at the same time offers the much needed relief of rest to the stricture

(5) *Condition of the prostate* An enlarged prostate is of great importance, not only from its power of obstructing the operation but from the changes which it brings about in the bladder. Thus it interferes with the efficient use of instruments, the picking up of a stone even with the blades reversed and the finding of the last fragment. Again the use of the lithotrite and the passage of evacuating tubes readily lead to hæmorrhage, and this again by clots prevents the free and easy use of the evacuator. Later on phosphatic deposit, imperfect evacuation, residual urine and recurrence of stone symptoms are all frequent accompaniments of enlarged prostate. Therefore suprapubic cystotomy should be adopted, so that the chief cause of trouble, the enlarged prostate can be removed either at the same time or later, after the renal function has improved

(6) *Condition of the bladder.* Some changes¹ in the bladder require mention. (a) When the bladder is so irritable and contracted that it will not admit the four or five ounces of water which are necessary for safe crushing lithotomy must be adopted. (b) *Sacculation.* Suprapubic lithotomy is strongly indicated when a stone is in a diverticulum or sacculus as shown by radiographic or cystoscopic examination or strongly suggested by other evidence. Similarly, a stone impacted at the lower end of the ureter, or in the prostatic urethra is best removed by suprapubic cystotomy. (c) When a growth co exists with stone suprapubic cystotomy is indicated. (d) Spasmodic contraction of the bladder around a stone may make lithotripsy too difficult and dangerous

(7) *Condition of the kidneys.* When nephritis or pyelonephritis or depressed renal function is present, as a result of ascending infection and back pressure, litholapaxy is contra indicated and suprapubic lithotomy with free drainage of the bladder is far preferable

(8) *Age.* Litholapaxy is difficult in young male children, but Keegan has shown that in skilful hands it is preferable to other methods when suitably small instruments are available

Sir J Thomson Walker² did this operation successfully on a boy aged 15 months

(9) *The risk of recurrence.* At the Mayo Clinic³ the recurrences were 7.94 per cent after 153 litholapaxies and 4.5 per cent after 395 suprapubic lithotomies. Recurrence has been more frequent after litholapaxy because of the great difficulty of getting the fragments and grit away, even

¹ Several allied conditions exist in which the position of the stone is complicated with difficulties, e.g. (1) where the stone has been partly in the bladder and partly in the urethra.

(2) The stone has been lodged entirely or partly in a diverticulum of the bladder. (3) The stone has been lodged in a deep pouch behind the prostate

² *Genito-Urinary Surgery* 1914 p. 507

³ J. L. Crenshaw, *Collected Papers of the Mayo Clinic*, 1922, xiv, 328.

with the most careful washing; cystoscopy, either immediately after the litholapaxy or soon afterwards, is a valuable safeguard against recurrence from this cause. The evacuation can be repeated at any time with very little inconvenience and litholapaxy itself can be repeated if necessary, whereas repetitions of lithotomy are increasingly difficult and more formidable from the patient's point of view.

LITHOLAPAXY

Examination and preparation. The patient is kept at rest for twenty-four hours or more on a light farinaceous and liquid diet. The urine is examined to determine the state of the kidneys. If there is evidence of pyelonephritis or of diminished renal function it is necessary to measure the blood urea, and to decide between litholapaxy and lithotomy. In either case it will be necessary to prepare and diet the patient very carefully for some days or even longer. If there is chronic cystitis 10 grains of urotropine and 10 to 30 grains of acid sodium phosphate should be given

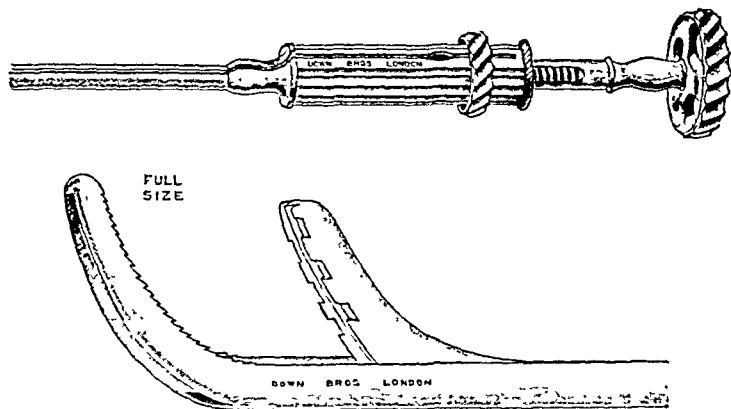


FIG. 323. Milton's lithotrite.

three times a day and the bladder washed out twice daily if necessary. The bowels are regulated with mild aperients and an enema given if necessary about twelve hours before the operation, the pubis is shaved and the parts are as carefully prepared as for any cutting operation.

Instruments. Lithotrites of various sizes ($4\frac{1}{2}$ to 18) and character are required according to the size of the urethra and the size and hardness of the stones to be crushed. The female blades should be fenestrated, so that debris cannot accumulate in the instrument, and the locking action should be simple and easy. Those of Freyer and Milton are very simple and convenient. Milton's evacuating lithotrite avoids much changing of instruments and urethral damage in troublesome cases; the rubber tube stands boiling and, as it is attached by a metal clip, there are no joints to get out of order. H. H. Young's¹ evacuating cystoscopic lithotrite gives the further advantage of sight, but it is not so strong as other lithotrites and should not be chosen for large, hard calculi. His cystoscopic rongeur is useful to pick small calculi out of sacculi. Freyer's combines the separate virtues of the older instruments of Thompson and Bigelow. It

¹ *Practice of Urology*, 1926, ii, pp. 400 and 405.

is well to have several evacuators prepared so that they may be used alternately to save time. The cannula should be slightly curved and vary in size between 6 and 18 English scale. They should have stylets. Conical steel sounds from 6 to 18 should be at hand for the urethra may need dilating to a limit a suitable lithotrite.

Operation in Adult Males. The patient is anaesthetised¹ on a firm narrow and rather low table. His pelvis is raised by a firm flat cushion so that the stone falls back from the neck of the bladder to the wider base where it can be more easily and safely crushed. The body and lower limbs which are separated and slightly flexed are well protected from chill the latter by very long woollen stockings. The surgeon stands on the right or between the legs of the patient with all his sterilised instruments close to him. The bladder is washed out and four ounces of sterilised water left in. Too much water makes the operation far more difficult. When the meatus is too small it must be enlarged downwards with a scalpel introduced into it. When the urethra is small or a very large lithotrite or cannula is to be used conical steel sounds are introduced to dilate it. Very small stones do not need crushing but can be evacuated through a large cannula. The lithotrite is accurately closed locked well lubricated and held horizontally in the right hand with beak entering the urethra as the penis is drawn forwards by the left hand.

In introducing the lithotrite care must be taken not to get the beak hitched either just in front of the triangular ligament or on the roof of the prostatic urethra. This will be secured by not depressing the instrument till very late—in fact not till it is just about to enter the bladder. The instrument well warmed and oiled is held at first horizontally over the groin or abdomen the penis being drawn over it the shaft being all the time gradually brought into the vertical position as the instrument finds its way by its own weight into the bulbous membranous and prostatic urethra. Now and not before the handle is somewhat depressed and the instrument glides quickly into the cavity of the bladder. If the prostatic urethra is enlarged and lengthened the surgeon may think that he has reached the bladder but the fact that the gentlest lateral movement of the lithotrite is interfered with will show him his mistake. Pressure with the instrument is allowable only at the meatus some rotation may be called for in guiding the instrument through the triangular ligament or past an enlarged prostate. In this latter case also the handles must be further depressed.

When the lithotrite has entered the bladder it should be allowed to slide very gently down the trigone until the beak touches the posterior wall of the bladder. The latter is gently pressed back making a depression into which the stone must fall and come in contact with the instrument which is now opened and closed on the stone.

If the stone be felt on one side the instrument is gently turned to the opposite one opened and then turned towards the stone. If it be not felt the handle of the instrument being slightly raised and the blades very gently depressed and then opened the stone will often drop into them.

If this fail the instrument is turned open first obliquely then more

¹ Whereas a general anaesthetic is necessary for children, local anaesthesia, 5 per cent novocain for the bladder and urethra and twilight sleep suffice for nearly all adults.

horizontally, first to the one side, then to the other. In the event of the stone still eluding the lithotrite, which is most unlikely, it should be sought for with blades turned downwards behind the prostate. To effect this, the blades, closed, are raised off the bladder floor by depression of the handle, carefully reversed, and then depressed again so as to sweep lightly over the floor. They are then gently opened and closed, vertically first, and then obliquely, so as to complete the examination.

During the above, the following points must ever be borne in mind :

- (a) The handle and shaft of the lithotrite are to be kept as steady as possible, so as not to jar the sensitive neck of the bladder needlessly.
- (b) All movements are to be executed at or beyond the centre of the vesical cavity, the proper area of operating, without hurry, rapid movement¹ or any other which partakes of the nature of a jerk or concussion

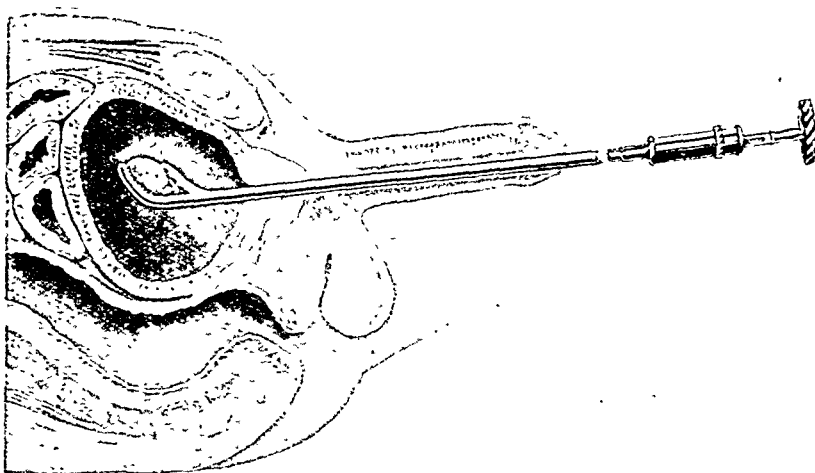


FIG. 324. Litholapaxy. The stone is brought forwards into the middle of the bladder, and the jaws of the lithotrite are rotated forwards before crushing is commenced.

- (c) The male blade is never to be brought into contact with the neck of the bladder, unless this is rendered necessary by the position of the stone.

The stone being seized by one of the above manœuvres and the screw connected—the screw is gradually turned at first to make the jaws bite, since a sharp turn at this time may drive the stone out either to right or left—the calculus is then carried to the centre of the cavity, which will show whether a fold of mucous membrane has been seized (Fig. 325). As the screw is applied more and more forcibly, one or other of the following will be noticed. If not well caught and if hard, the stone will be pushed out of the jaws ; if hard and well gripped, it is felt to split into fragments : if soft and held, it crumbles down. If extremely hard, as a pure lithic acid or oxalate, any attempt at advancing the screw is met by this distinctly recoiling instead of advancing. Each surgeon must now decide for himself, according to his knowledge of his instruments and

¹ " Rapid movements produce currents which keep the stone more or less in motion, so that it is less easily seized than when the surrounding fluid is in a state of rest " (Sir Henry Thompson).

reliance on his power to deal with large hard fragments whether to continue or at once to perform lithotomy. If he continue the resistance will be felt to give way in the case of a very hard stone, by a sudden sharp crack, in one less hard, more gradually. If the stone does not crack Freyer¹ advises that the lithotrite be unscrewed the stone caught in another axis, and the lithotrite again screwed home. By repeating this, if necessary the stone will usually give way. The same surgeon also recommends that in dealing with stones which are more or less round and so large that the lithotrite will not lock in any direction the jaws of the instrument should be dug into one side of the stone and screwed up, a portion of the crust being thus broken off. By repeating this a number of times sufficient reduction in size will take place to allow of the lithotrite being locked on the stone. In overcoming much resistance the surgeon either screws up the male blade as hard as he can and keeps it so or, having gently unscrewed it a little screws it up again with a series of light

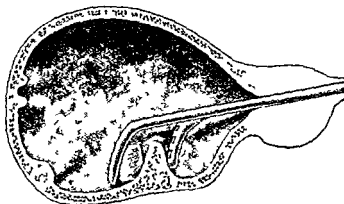


FIG. 350. Litholapaxy. This shows the risk of crushing without turning forwards the blades of the lithotrite.

jerks so as to communicate blows to the stone. Cracking of the stone having taken place the fragments will usually fall close to the original site. Thus the lithotrite has only to be kept as immovable as possible to ensure on drawing out and again closing the male blade, the seizure of a fragment². This is crushed and the process repeated again and again until all the fragments have been well crushed, so that the instrument need not be reintroduced. The lithotrite is then withdrawn firmly screwed up.

A straight or curved evacuating tube No. 16 for a stone of moderate size, and 18 for a large one is then introduced the evacuator, filled with a warm solution of boracic acid is connected, the meatus being first incised with a narrow probe pointed bistoury downwards by the side of the frenum, if needful. The tube, if curved, should be held downwards at first, but not quite on the bladder floor, then to one side or the other,

¹ *Loc. supra cit.*

² It is not always easy to distinguish between a piece of soft stone enveloped in inspissated mucus and the lining membrane of the bladder.

then upwards, washings being carried on at the time that these movements are made. A straight tube should lie with its orifice just within the neck of the bladder. While his left hand supports the evacuator, with his right the surgeon gently but quickly squeezes the bag with sufficient force to send in about two ounces of fluid. On relaxing the pressure an outward current takes place, bringing with it crushed fragments. Sir H. Thompson recommends that, after the bag has expanded and the current apparently ceased, the surgeon should wait a few seconds, "as at that precise time it is quite common for one or two of the larger fragments to drop into the receiver which would have been driven back, perhaps, by too rapidly resuming the pressure."

If, after several washings, the outflow stops, and the bag no longer expands, the end of the evacuator is blocked either by a fragment of stone, a small calculus, a clot of blood or the mucous membrane of the bladder. If it be a fragment, as is usually the case, or a clot, dislodgment may be effected by sending in quickly a gush of fluid or by the use of a

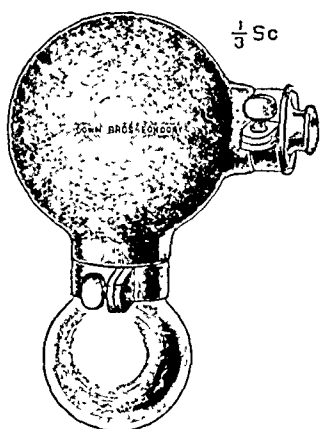


FIG. 326. Milton's evacuator.
(Down Bros.)

stylet, after unscrewing the tube. Impact of the bladder generally takes place when a curved evacuator is turned upwards, and when the bladder is empty. The sensation given may be a kind of flap, simulating the click of a fragment; more often it is a dull, vibrating thud, easily recognised. More fluid must be at once injected.

If a large fragment is felt striking against the tube or if the surgeon is certain that several good-sized fragments remain, he removes the tube and evacuator, introduces a small lithotrite and crushes up all the remaining fragments, and goes on again with the washings.

All the time the surgeon must keep before his eyes a mental picture of the interior of the bladder, perhaps diseased, the ureters, perhaps dilated, leading up to kidney pelves enlarged, and remember that the effects of any squeeze of his hands are felt, not only all over the bladder, but perhaps in the ureters and kidneys as well.

Detection and Seizure of the Last Fragment. This is, as is well known, a matter of much difficulty, owing to the facility with which small fragments get hidden in some folds of mucous membrane or enveloped in blood-clot. As long as there is any "clicking" against the tube, the surgeon must persevere in his attempts at complete removal. If, after several washings, nothing comes out into the receiver, the surgeon should listen carefully over the bladder, as thus advised by Dr. Keyes: ¹ "The tube is turned in various positions, and the operator listens. The swish of the water as it rushes in and out is heard with startling distinctness, and if the management of the tube is skilful, any fragment of stone lying loose in the bladder is sure in a short time to be driven against the metallic tube so as to announce its presence by a characteristic click, quite distinct from

¹ *Intern. Encycl. of Surgery*, vi, 246. The whole of this account, with its vigorous language, will well repay perusal.

that emitted by the flapping of the bladder wall against the eye of the instrument. Fine sand and thin scales of stones make no sharp click, but any piece large enough to require the lithotrite can hardly escape detection by the educated ear."

Time occupied in Litholapaxy This may be, on an average, from half an hour to an hour and a half. Professor Bigelow¹ operated continuously for upwards of three hours, removing 744 grains, the patient making a good recovery.

OPERATION IN MALE CHILDREN

This mode of treating stone was strongly advocated by Surgeon Major Keegan,² who, after a wide experience of large stones in India, believed that the objections to litholapaxy in boys are not valid. Thus (1) as to the *smallness of the bladder*, the bladder of a boy of even only three or four is, as a rule, quite roomy enough to permit of the efficient working of a small lithotrite and a medium or full sized aspirator if gently worked. The bladders of boys with stones are, as a rule, healthy and will stand more distension proportionately to their capacity than the bladders of old men. (2) *The extreme sensitiveness of the mucous membrane of the bladder*

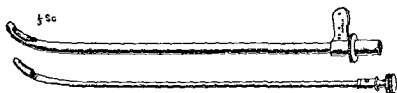


FIG 327 Curved evacuating tube (Down Bros.)

and urethra, with an anæsthetic, this may be safely disregarded. (3) *The liability to laceration of the mucous membrane of the bladder and urethra*. This objection is a theoretical one only. (4) *The small calibre of the urethra*. Keegan stated that not only is the calibre of the urethra in boys of six or eight not very small but that of boys of only three or four is sometimes very large. As in men, the true calibre of the urethra cannot be told unless the meatus, which is sometimes very small, is incised. Speaking generally, the urethra of a boy from three to six will admit a No 7 or a No 8 lithotrite (Eng scale) and that of a boy of eight or ten will admit a No 10, a No 11, and even sometimes a No 14.

In a later publication³ Mr Keegan gave the results of a series of 500 litholapaxies in boys. He says "Grouping the 500 litholapaxies together, the work mainly of three surgeons, I find that the average age of the boys operated on was six years, the average weight of stone removed at each operation was ninety five grains, and the stay in hospital after operation amounted to four days. The mortality, as already stated, was 41, or 2.2 per cent." Of the 500 operations, Mr Keegan did 239, and lost 5 cases, the cause of death being extensive kidney disease. Mr Keegan had constructed by Messrs Weiss a No 3½ lithotrite, which has done very

¹ *Amer Journ Med Sci*, January, 1878.

² *Litholapaxy in Male Children and Male Adults* (Churchill, 1887), *Lancet*, 1886.

³ *Ind Med Gaz*, August, 1900.

good work, and advises any one wishing to give litholapaxy in boys a fair trial to provide himself with a set of completely fenestrated lithotrites running from No. 4 to No. 10 (Eng. scale).

Mr. Keegan insisted upon the completely fenestrated lithotrite as being the only perfectly safe instrument to use, as, with any other, clogging of the blades is a very likely and a most dangerous complication.

Owing to the infrequency of calculus in children in recent times, and the fact that, as a rule, isolated cases—and only successful ones—are alone published, it is very difficult to speak definitely about the results of litholapaxy in children in European surgery. Sir Gilbert Barling¹ found that the mortality in 59 litholapaxies in males under twenty years of age was 5 per cent. It is rarely wise to use this method for large stones in young children. Edmund Owen, with praiseworthy candour, brought a case before the Medical Society² in which fatal rupture of the bladder had taken place during litholapaxy in a boy aged 4. Litholapaxy is risky in children, and entails the presence of special skill and expensive instruments, and always at any age must risk leaving fragments which may lead to recurrence. Cystoscopic examination after the evacuation should lessen this risk.

PERINEAL LITHOLAPAXY

This operation—first suggested and carried out by Dolbeau—consists essentially of lithotritry through a small median perineal incision.

Surgeon-Major Keegan³ thought that the operation would supersede suprapubic lithotomy in dealing with large stones in the bladder. Reginald Harrison⁴ also recommended the operation, having performed it fifteen times without a death or recurrence.

Some of the chief points claimed in favour of this operation are: (1) Large stones may be crushed in a short space of time. (2) It may be performed in cases of stricture. (3) It is less severe than the suprapubic operation. (4) Excellent drainage is provided in cases of cystitis, &c. (5) Digital examination can be made use of to determine whether all the fragments have been removed.

Operation. A small median perineal incision is made on a grooved staff, as in lithotomy, sufficiently large for the introduction of the finger into the bladder for the purposes of examination. The “giant” lithotrite specially devised by Mr. Keegan⁵ is then introduced into the bladder and the stone crushed as in ordinary lithotritry. The fragments may be removed either by means of forceps or an aspirator connected with a specially large evacuating cannula. A tube is then introduced into the bladder through the wound for purposes of drainage.

Mr. Keegan says that the specially strong “giant” lithotrite devised by him, which is of the size of a No. 20 catheter in the stem and of No. 25¹/₂ at the angle, “will readily break up a hard calculus weighing six to eight ounces.”

After-treatment. In bad cases, especially with bleeding, it is wise

¹ *Brit. Med. Journ.*, 1894, i, 958.

² *Lancet*, 1891, i, 665.

³ *Brit. Med. Journ.*, 1897, ii, 23.

⁴ *Ibid.*, December 12, 1896.

⁵ *Ibid.*, 1897, ii, 23.

to tie in a large soft catheter for forty eight hours. Other important points are rest in bed, the patient turning on his side to pass water, for the first few days, hot fomentations to the abdomen and perineum and hot bottles at first, morphia subcutaneously, if indicated, warm milk, barley water, mineral waters or lemonade a little whiskey or brandy, being given if needful. All chills should be carefully avoided. Mr Milton¹ recommends salicylate of soda, at first every two and then every four hours, if there is fever, and diuretin if there is diminution of urine. If cystitis is present, urotropine in doses of 10 grains thrice daily should be given.

In addition to the above, hot hip baths, the occasional passage of a soft catheter and rendering the urine alkaline will give much relief.

Results. The late Sir P. J. Freyer² performed 1,358 operations for vesical calculus —

Operation	No	Deaths	Mortality
Perineal lithotomy	252	11	4.36 per cent
Suprapubic lithotomy	116	11	14.65 "
Vaginal lithotomy	1	0	
Rapid dilatation of urethra in females	3	0	
Litholapaxy	988	23	2.53 "

Seven hundred and ninety six of the litholapaxies were in adults, with 23 deaths or 2.88 per cent, 190 were in children from 1½ to 16 years, with 2 deaths or 1.05 per cent. Suprapubic lithotomy was reserved for large stones and bad risks and naturally carried a high mortality.

At the Mayo Clinic³ the mortality of 153 litholapaxies was 1.3 per cent, and of 395 suprapubic lithotomies 8.6 per cent.

Litholapaxy has lowered the mortality of stone in the bladder to less than a third of its former level, but recurrence of stone is usually twice as common as after lithotomy.

Complications after Litholapaxy. These are much the same as those occurring after lithotomy. The chief differences are the greater liability to rigors and urinary fever and the greater frequency of epididymitis.

TREATMENT OF STONE IN THE BLADDER IN THE FEMALE

Practical Points. Vesical stones are very rare in women owing to the large size and straight course of the female urethra which allows the easy exit of a stone which is small enough to descend along the smaller ureter. The absence of any prostate or of a fixed smooth trigone surface is of importance here, especially with regard to litholapaxy. The aid given by a finger in the vagina, the dilatability of the urethra and the association of calculi with foreign bodies are also well known. It is only occasionally that enlargement of the uterus or prolapse of the vaginal wall of the bladder interferes with the treatment of stone.

Operation. We have here the following three methods to consider.

(1) **Dilatation.** When the stone is small—the size of a filbert, a

¹ *Lithotomy, Simple and Complicated*, *Lancet* April and May, 1896.

² *Surgical Diseases of the Urinary Organs* 1908 pp 334-339.

J. L. Crenshaw, *Collected Papers of the Mayo Clinic*, 1922, xiv 329.

stone not exceeding three-quarters of an inch in its largest diameter—it may be safely removed after rapid dilatation with Kelly's dilators, followed by a finger (the little one first).

It is not meant by this that much larger stones have not been successfully passed and removed from the female bladder. Thus, Dr. Yelloly¹ gives a case in which a stone, weighing 3 ounces $3\frac{1}{2}$ drachms, was extracted; incontinence followed, and this is a very troublesome sequel which must be avoided at all cost. Where large calculi, *e.g.* of 6 ounces, have come away spontaneously, it has usually been by a process of prolapse and ulceration combined. We do not yet know what is the greatest dilatation which the female urethra will safely bear. Perhaps the limit given above is, if anything, too small. Erichsen² gives "eight or ten lines in diameter" as the size of a stone which can be safely extracted by this means. Sir H. Thompson³ says, "Dilatation should never be employed for any calculus larger than a small nut or a large bean in an adult, which limits its application to a very few cases." Sir Peter Freyer⁴ preferred suprapubic cystotomy to urethral dilatation or vaginal lithotomy when litholapaxy, the method of choice, was impracticable.

Dr. Keyes⁵ does not recommend dilating the urethra more than three-quarters of an inch.

(2) **Litholapaxy.** By this means calculus in the female bladder may be most frequently and efficiently treated. Thus, hard stones under 2 ounces and phosphatic ones of a much larger size may be dealt with at one sitting. The character of the ring or sound with the staff, the bite of the lithotrite, the cystoscope and the condition of the urine will aid here. A shorter instrument will be found much more convenient to work with. Where there is much irritability of the bladder, much difficulty will be met with in keeping fluid in it, owing to the absence of a prostate and the shortness and directness of the urethra. The pelvis must be well elevated, the patient placed fully under the anæsthetic, and the finger of an assistant in the vagina should make pressure on the posterior lip of the urethra against the lithotrite. In other respects the operation resembles that already fully given for the male (p. 625). The dilatable urethra admits a large evacuating tube.

(3) **Lithotomy.** This operation is called for when the stones are multiple,⁶ when one is large, especially if mainly hard as well, when there is a foreign body as a nucleus, when there is great irritability with ulceration of the bladder or when a growth co-exists.

Of the following methods—(a) vaginal, (b) suprapubic, (c) urethral, and (d) the lateral method of Buchanan—the first two only need be alluded to.

Vaginal Lithotomy. By this is meant extraction of a stone through an incision in the anterior vaginal wall, behind the vesical orifice of the urethra, and thus not interfering with this canal at all.

This anterior wall is about four inches long in the adult; in relation

¹ *Med.-Chir. Trans.*, vi, 574.

² *Surgery*, ii, 1024.

³ *Syst. of Surg.*, iii, 308.

⁴ *Surgical Diseases of the Genito-Urinary Organs*, p. 319.

⁵ *Intern. Encycl. of Surg.*, vi, 297.

⁶ As in Dr. Galabin's case (*Obst. Soc. Trans.*, April 7, 1880), in which twelve large calculi and about fifty smaller ones were removed successfully by vaginal lithotomy from the bladder of a woman aged 61.

with it anteriorly is the urethra, to be felt as a cord through this wall, behind thus the bladder, and farther back the os and cervix uteri. No peritoneum is normally in relation with this wall, as this membrane leaves the uterus half way down to pass directly on to the bladder. No important vessels or nerves are met with in vaginal lithotomy, but this, though the simplest and easiest of all the methods of cutting for stone, will be but rarely called for, as small stones can be removed after dilatation, litholapaxy is usually available for the removal of all moderate stones in women, while in the case of larger ones the suprapubic method is indicated. The serious drawback of a vaginal lithotomy in women is the risk of a fistula.

Suprapubic Lithotomy This is the best way to remove large stones from the female bladder, especially if these have formed round sharp or pointed metal foreign bodies such as hair pins, needles, &c.

I would refer my readers to a case of suprapubic lithotomy by Mr Barwell in a child, aged 9 from whom a stone weighing $2\frac{1}{2}$ ounces was successfully removed. It is interesting to note that Mr Barwell was led to adopt the suprapubic operation from his having had within seven months no less than three cases of vesico vaginal fistulae originating in the extraction of calculi during infancy and youth by different surgeons.¹

SUPRAPUBIC LITHOTOMY (Figs 307 to 309)

Indications. The surgeon who has the opportunity of becoming an adept in the use of the lithotrite will seldom have occasion to perform suprapubic lithotomy. Where however, there has been no such opportunity, this operation will be required for the following conditions.²

Suprapubic lithotomy will be found of great value by those who only have to deal with stone occasionally, and by those who find themselves face to face with calculi of large size in adults.³ The operation will be found useful (a) in many cases of large hard stones, (b) in multiple hard stones, (c) in some cases of foreign body in the bladder with abundant calculous deposit, (d) in cases of encysted stone,⁴ (e) in the rarer cases of a state of urethra which will not admit the use of a lithotrite or a grooved staff, (f) in cases where the stone is associated with enlarged prostate (p 680). The suprapubic opening will here be convenient for removing the prostate as well as the stone, and also for thoroughly examining the interior of the bladder and removing all the calculi with certainty. The calculus is generally secondary to the prostatic enlargement, so that it is necessary to remove the prostate to give complete and permanent relief. The prostate may be enucleated either at the same sitting or later if there is much cystitis, or the renal excretion is seriously lessened. Free drainage and the removal of the stone may be followed by great improvement, and a secondary prostatectomy then undertaken successfully. (g) In cases of sacculation of the bladder, or where a stone has been seen

¹ *Med Chir Trans*, 1886 lxi, 342

² W H A Jacobson *Trans Roy Med Chir Soc*, 1886, lxi, 377

³ Dr Randall removed a stone weighing four pounds (*Journ Urol*, 1921, v, 119-125)

⁴ Much useful information may be gathered from a paper by Mr Bruce Clarke (*Brit Med Journ*, May 13, 1899), in which an account is given of 27 cases of encysted vesical calculus

through the cystoscope to be impacted at the ureteral orifice with a projection into the bladder; (*h*) in cases where stone is associated with new growth of the bladder.

Operation. Cystitis must be treated as far as possible by rest and by irrigation of the bladder for some days before the operation, and by the administration of urinary antiseptics. Urinary excretion may be promoted by copious libations and by diuretics, and the bowels should be kept open. The bladder is washed out, filled and opened as already described under suprapubic cystotomy (p. 601). A small incision is made into the bladder, and the left index finger is at once introduced to feel for

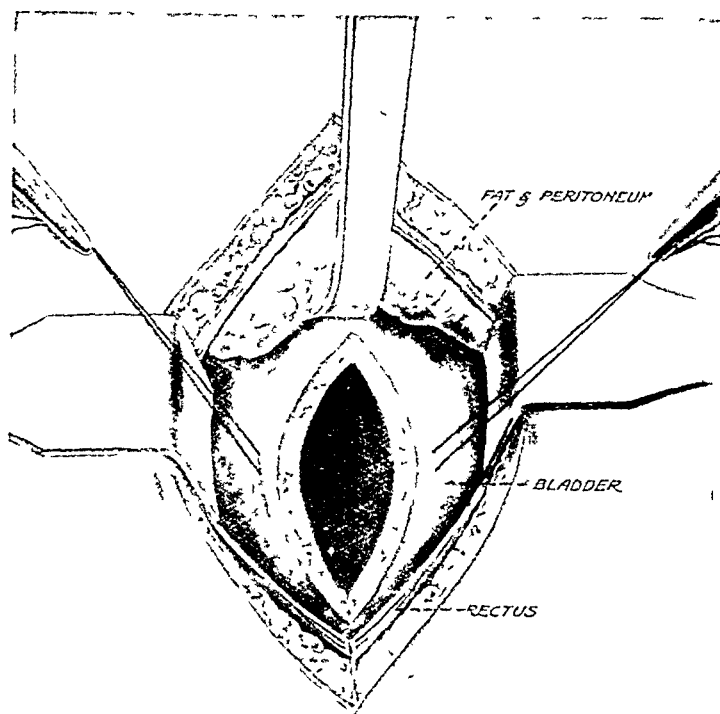


FIG 328. Suprapubic lithotomy. The peritoneum and subperitoneal fat are drawn up. The bladder is held forward by sutures.

the stone, as the water is allowed to run out through the catheter. The finger at the same time keeps the bladder hooked up and prevents it settling back into the pelvis as it empties. The stone is best removed by forceps or scoop. Removal is not always easy; the stone falls back into a retroprostatic pouch out of reach. An assistant's two fingers passed into the rectum may be of service in pushing the stone forwards. Care must be taken not to bruise or lacerate the edges of the vesical incision or to break the stone into pieces by attempting to remove it through an aperture which is too small; it is far preferable to enlarge the latter by stretching with two fingers without delay. More room can thus be obtained without increasing the bleeding from the wall of the bladder. All *débris* must be carefully removed with the scoop and by irrigation. Careful search must

be made for encysted calculi and for stone in sacculi. The Trendelenburg position, good self-retaining bladder retractors and a head light are invaluable.

Great difficulty may be met with in removing an encysted calculus owing to the fact that the stone usually entirely fills the sac, the neck of which is frequently quite narrow. If the neck cannot be sufficiently dilated to deliver the stone, the latter may be broken up with suitable forceps and removed in pieces. When the sac is low down or lateral, the lower margin of its neck may be safely incised without risk of opening the peritoneum. A stone impacted at the lower end of the ureter may if necessary be released by incising the mucous membrane over it in a direction parallel with the course of the ureter. In some cases when no stone is found in the bladder, one will be discovered in the prostatic urethra on passing the index finger into this. The stone is easily dislodged and removed. Occasionally a stone forms in the cavity left after prostatectomy. This is usually large, rough, firmly impacted and very difficult to remove until the neck of the bladder is incised over the calculus in the middle line behind.

The question now arises of closing the opening with sutures or leaving it open, in part at least.

When there is little or no cystitis or bleeding and the renal function is good, the bladder is closed. One of the first to adopt this plan successfully was Dr. L. S. Pilcher of New York; a catheter was used till the ninth day, the patient, an adult, went out on the fourth, and on the fourteenth day was shown to the New York Medical Society, primary union having taken place throughout the whole extent of the wound without unpleasant symptoms of any kind. Mr. R. W. Parker had an equally successful case in a child aged 3, and since then similar cases have become quite common, but occasionally some urine leaks any time from the third to the ninth day. Hence the importance of leaving a small tube at the lower angle of the parietal wound for three or four days to prevent the possibility of extravasation of urine and pelvic cellulitis—a grave complication. The drain should not lie in contact with the bladder, but only just reach the prevesical space. A continuous Connell suture of catgut, put in efficiently, suffices and prevents bleeding into the bladder from the wound in its anterior wall. The first suture may be reinforced by a second one in some cases, especially if there has been any bruising of the edges. When the bladder is sutured, great care must be devoted to securing and maintaining efficient drainage through the catheter, for if the bladder is allowed to get distended, pelvic extravasation is almost certain to occur. A large-sized and large-eyed soft catheter is inserted before the bladder is closed, and its eye should be just above the vesical orifice. It is carefully secured so that it cannot slip either in or out, and the rubber tubing attached to it has its other end immersed in antiseptic lotion in a vessel attached to the side of the bed. The whole drainage apparatus must be air-tight to be efficient. If the eye of the catheter gets blocked with clot, this must be displaced at once by running in some boracic lotion. Some vigorous patients, after accurate suturing, do not require a catheter, but prevent distension by micturating every two or three hours during the first few days.

Complete closure should not be employed (1) where there is cystitis

and the urine is ammoniacal or the kidneys diseased and the renal excretion poor ; (2) where the bladder is irritable, thickened and the better for drainage ; (3) where the extraction is difficult and prolonged, and the parts necessarily bruised ; (4) where there is any reason to expect bleeding : in such cases the clots will cause violent tenesmus and, probably, giving way of the sutures ; (5) where there is any stricture or an irritable condition of the urethra.

The bladder is drained and the wound dressed as already described (p. 603).

Mortality. Southam ¹ records a death-rate of nearly 24 per cent. for 46 suprapubic lithotomies. This mortality is unusually high ; “ it must be remembered, however, that the cases so treated were all unsuited for lithotripsy, the latter operation being contra-indicated in each instance—with one exception—on account of the large size of the stone, associated either with enlargement of the prostate and an unhealthy state of the bladder and urine, or with a feeble condition of the patient, in consequence of which the shock of a prolonged crushing operation would not have been well borne. The fatal result in these cases was due in several instances, when the patients were advanced in years, to sudden heart failure, coming on at some interval after the operation, when all was apparently progressing favourably ; in others, as proved by necropsy, it was the result of pre-existing secondary renal disease, death being preceded by suppression of urine and other evidences of uræmia.”

P. J. Freyer ² in 149 suprapubic lithotomies in adults had a mortality of only 12.75 per cent., although prostatectomy was performed at the same time in 110 of these cases. Improvements in the selection and preparation of patients and in technique should reduce the mortality well below 10 per cent.

MEDIAN PERINEAL LITHOTOMY

This operation is rarely performed.

Disadvantages. (1) It gives very little room, and is unsuited to any save the smallest stones. (2) The wound being small, the surgeon cannot reach the bladder easily with his finger. Only the base of the bladder can be explored, so that a stone in a pouch may be overlooked. (3) The rectum on the one hand and the bulb on the other are in danger. (4) Troublesome bleeding is frequent. (5) Laceration of the sphincters may lead to incontinence of urine.

Mr. Cadge, having operated on 50 or 60 cases by the median method, gave it up for the above reasons, and also because his mortality was too high. For these reasons the suprapubic operation has almost entirely replaced it for large stones ; for small stones litholapaxy is much better.

Advantages. Recovery is often extremely rapid ; the urine quickly resumes its natural route ; and the wound, instead of gaping and healing slowly as the lateral wound does, heals almost by first intention.³ It

¹ *Brit. Med. Journ.*, 1904, p. 1190.

² *Burghard's System of Surgery*, iii, 518.

³ Dr. W. T. Briggs, of Nashville (*Trans. Amer. Surg. Assoc.*, v, 127), thus sums up the advantages of median lithotomy : (1) It opens up the shortest and most direct route

inflicts a minimum of damage unless the stone is large, for these reasons Mr Jacobson considered the operation to be the most suitable for elderly men with comparatively small stones where litholapaxy is impracticable. It is especially valuable for the removal of stones lodged in the prostatic urethra which cannot be displaced back into the bladder for crushing and in cases where a troublesome resilient or complicated stricture needs vigorous treatment at the same time. In most cases of stone in old men enlargement of the prostate with partial retention is the cause of the formation and then the crushing or removal of the stone affords but temporary relief. Therefore suprapubic exploration with removal of the stone and if necessary enucleation of the prostate is indicated or the stone may be removed through the perineum at the end of perineal prostatectomy with little added risk. Although the mortality of the perineal combined operation is said to be lower most surgeons prefer the suprapubic route for these cases.

Operation. The patient is carefully prepared so that the rectum is empty and not likely to act during the operation. He is placed in the lithotomy position and a curved staff with a wide groove along its convexity is passed and then held by an assistant so that its handle is inclined towards the umbilicus and its convexity is pushed downwards towards the perineum. The assistant also holds the scrotum forwards out of the way. The surgeon sits facing the perineum and makes a median incision two inches long with its posterior extremity an inch in front of the anus so that the bowel and its sphincters are not damaged. As the incision is deepened the point of meeting of the perineal muscles and the sphincter ani is seen and a transverse incision is made separating the external sphincter from the ejaculator urinae. The bulb is drawn forwards and the membranous urethra made prominent by means of the staff is seen and felt. The left forefinger feeling the groove on the staff guides a long narrow bladed knife to open the urethra and the knife with its edge backwards is pushed on along the groove until it reaches the prostatic urethra. The knife is withdrawn and a conical probe pointed director with a wide groove is run along the groove on the staff until it reaches the bladder as shown by a rush of urine. The left forefinger is passed along the director into the bladder to explore the base but in spite of suprapubic pressure only a limited exploration is possible and it is difficult to insert the finger through the narrow and deep neck of the bladder. If the finger cannot be introduced into the bladder forceps of different sizes may be passed and used to dilate the passage. A small stone is removed with a scoop or long handled lithotomy forceps. If the stone is too large to be extracted in this way a slight bilateral cut is made in the neck of the bladder, care being taken not to destroy the sphincter. A rubber tube is inserted into the bladder sewn to the perineal skin and left in for two days.

Mortality.—In 252 perineal lithotomies P. G. Freyer¹ had a mortality of nearly 20 per cent in 52 adults and 0.5 per cent in 200 children.

to the bladder. (2) It divides parts of the least importance. (3) It is an almost bloodless operation. (4) It affords a passage for any calculus which can be safely extracted through the perineum. (5) It affords the best passage for the fragmentation of unusually large calculi. (6) It reduces the death rate to a minimum.

¹ *Surgical Diseases of the Urinary Organs* 1908 p. 331.

TUBERCULOUS CYSTITIS

Tuberculous disease of the bladder is nearly always secondary to similar diseases of one kidney. Cystoscopic examination often shows cystitis limited to the neighbourhood of the corresponding ureteral orifice, which may be dilated, ulcerated, retracted or discharging pus or *débris*. Little or no indigo-carminé may escape from that ureter while it issues very freely from the opposite one. Catheterisation of the ureters with bacteriological examination of the separated urines may prove the disease to be unilateral. Later both the kidneys may be affected, and occasionally both kidneys are diseased from the beginning. Often the epididymis, especially on the corresponding side, is tuberculous, and the vesiculæ seminales, ejaculatory duct and the prostate are similarly affected. Nearly always the disease is primary in the lungs, lymphatic glands, bones or joints, and the infection is carried to the kidney or epididymis by the blood. Therefore, operations on the bladder are usually misdirected; the infecting and irritating kidney or testes should be removed without delay and the bladder heals, as a rule, without any interference. Occasionally cystitis persists after nephrectomy owing to the incomplete removal of a tuberculous ureter. In such a case excision of the ureter completely cured a patient who used to micturate every few minutes day and night. The patient was well ten years later.

Occasionally, however, *one or more definite localised deep tuberculous ulcers* may form in the bladder. Sometimes this condition is found after the removal of a tuberculous kidney. Such a localised chronic ulcer calls for cystoscopic fulguration to destroy it and promote healing.

Apart from localised chronic ulcer cystotomy is very rarely justifiable, and in any case is only to be considered after the removal of the infecting kidney.

Even in the rare cases when tuberculous cystitis is primary, it is an accepted fact that in tubercular affections in which it is not possible to remove the mischief operative interference may do more harm than good. Under such conditions the manipulations only irritate early tubercle into activity, and light up again obsolete or quiescent tubercle, besides causing certain dangers¹ peculiar to this viscus, viz. cystitis, pyelitis and vesical fistula.

If tuberculous cystitis persists after the removal of the infecting kidney, it should be treated, not by operation,² but by improving the hygienic surroundings, especially, whenever it is possible, getting the patient to be much in the open air, if possible by the sea. This method is certainly worthy of a thorough trial with the precautions and restrictions mentioned. Intravesical injections of iodoform emulsion, solutions of bichloride of mercury, chloride of zinc, or nitrate of silver are disappointing, painful and troublesome, and although they sometimes relieve

¹ Another ill result which is very possible here is rupture by even a moderately distending injection of a contracted, rigid bladder the seat of long-standing tubercular mischief, and one emptied for some time by irritability and incontinence. I would refer my readers to two such cases candidly published by Mr. H. Fenwick in his instructive book *Cardinal Symptoms of Urinary Diseases*, p. 200.

² Dr. L. Bolton Bangs, of New York, whose experience in diseases of the genito-urinary organs is a very wide one, thus expresses himself on this matter: "After faithful and zealous efforts to relieve by surgical interference the local symptoms of these cases, I have been forced to the conclusion that the less instrumentation we resort to the better."

symptoms they may aggravate the disease Rosving recommends a 6 per cent carbolic acid solution 30 c c injected once or twice a week. Internal administration of urinary antiseptics, such as urotropine, helmutol and others is often useless. Young recommends giving methylene blue by the mouth, finding that it relieves the symptoms. The cases that call for operative interference are those in which what I may be allowed to call hygienic treatment has failed, or in which the case has got beyond this, where pain is incessant, micturition frequent, *e.g.* every half hour, day and night, with much tenesmus and where opiates are required to afford sleep. V C Hunt¹ advises suprapubic cystostomy in such cases. If both kidneys are tuberculous, or one has already been removed, this operation may be performed for the relief of symptoms by draining the urine away and preventing distension of the exquisitely sensitive bladder.

Transplantation of the trigone or ureters into the rectum is rarely to be recommended for apart from the immediate danger, in these cases ascending nephritis is almost certain to develop sooner or later.

Cystectomy is far too dangerous an operation. Moreover, cutaneous ureterostomy without cystectomy relieves the symptoms.

Operation. The details of a suprapubic cystotomy are so fully given at pp 601 to 604, that it is needless to repeat them here. I will only add the caution that great care must be taken in distending these bladders. Four to six ounces will be as much as can usually be injected with safety. The bladder is first opened and its interior exposed with some suitable retractor (p 609) aided if needful by the Trendelenburg position (Fig 314, p 610). Any ulcers should be carefully and thoroughly fulgurated or cauterised with a fine point of the Paquelin thermo cautery.

If the operation is performed with the object of securing long continued drainage, only a small incision is made into the bladder, and a permanent suprapubic drainage apparatus fitted (p 599).

CHRONIC OR CALLOUS ULCER OF THE BLADDER

As pointed out by Fenwick,² chronic ulcer of the bladder sometimes occurs apart from cystitis or tuberculous or malignant disease. It is generally solitary, small, rarely more than half an inch in diameter, and situated near a ureteral orifice—often above and internal to this. Its edges are thick and somewhat raised, and its base is often covered with mucus or, later, with phosphatic crusts. It is nearly always found in young men, although a similar ulcer is occasionally found in women who have borne children.

It usually causes slight and sometimes profuse hæmaturia, frequency and great urgency of micturition with much straining. There is severe pain on the under surface of the penis near the peno-scrotal angle. Later cystitis develops and the general health deteriorates. Before cystoscopy, tuberculous disease of the bladder is generally suspected, but no tubercle bacilli can be found on repeated examination of the urine, and microscopic examination of the excised edge of the ulcer reveals signs of chronic inflammation but no tuberculous granulation tissue.

¹ *Collected Papers of the Mayo Clinic* 1923 xv, 429.

² *Ulceration of the Bladder*, 1900 and *Clinical Cystoscopy* 1934.

With time the size of the bladder diminishes so that only three or four ounces of urine can be retained. This is probably due to retraction of the muscle wall as a result of chronic reflex spasm.

This form of ulceration often fails to respond to medicinal treatment and local applications such as silver nitrate, the cautery or fulguration. Therefore it is often necessary to excise the ulcer, and it is better to do this early, before retraction of the bladder and deterioration of the general health occur.

Buerger¹ has removed the edges of the ulcer with the operating cystoscope, but it is better to adopt suprapubic cystotomy, which enables the surgeon to perform a more radical operation. The ulcer is excised and the wound sewn up with catgut, just as in the excision of growth of the bladder, except that there is no need to remove such a large margin of healthy tissue. V. C. Hunt² discusses submucous ulcers of the bladder and advises their excision and also the treatment of possible sources of infection such as teeth, tonsils or sinuses.

OPERATIONS FOR DIVERTICULA OF THE BLADDER

Diverticula of the bladder may be congenital, but they are far more frequently acquired. They are chiefly due to obstruction to the flow of urine from the bladder; the muscular tissue hypertrophies, becomes trabeculated, and pouches, consisting mostly of vesical mucosa, are forced out between the muscle bundles at weak spots where the large arteries enter (Targett). Sometimes a sacculus is found extending from the fundus into the lower part of the urachus and is the remains of the Allantois. Occasionally a pouch projects into the peritoneal cavity, but in the great majority of cases these accessory cavities are in the pelvic cellular tissues behind or to the side of the lower part of the bladder, and open often by narrow openings near one of the ureteral orifices. In nearly a third of the cases there are more than one diverticulum. Occasionally the ureter opens into the diverticulum, and is more or less obstructed by it. Apart from this, diverticula often press upon the ureter as it courses through the pelvic cellular tissue; and secondary changes in the kidney, such as hydronephrosis and pyelonephritis, with chronic uræmia, are the most serious consequences of these diverticula.

Another serious danger arises from the inability of diverticula to empty themselves by muscular contraction, for there is very little, if any, muscular tissue in their walls, which consist almost entirely of herniated mucosa. Moreover, their openings are usually small and often liable to complete closure during contraction of the bladder, and usually the sacs are ill-placed for drainage. Consequently decomposition of urine with diverticulitis is frequent, and stone formation is not uncommon. Diverticula are far more common in males, who mostly come for treatment after middle age; enlarged prostate is a common cause, but the symptoms are merged in those of enlargement of the prostate.

Symptoms. After urination the patient often feels that he has not emptied his bladder, and upon trying again soon afterwards he may pass

¹ *Med. Record*, April 12, 1913.

² *Surg., Gynecol. and Obst.*, April, 1922, p. 331, and *Collected Papers of the Mayo Clinic*, 1921, xiii, 373.

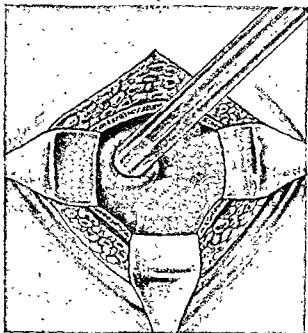


FIG. 329. Diverticulum of the bladder turned inside out by means of the vacuum glass tube. (After H. H. Young.)

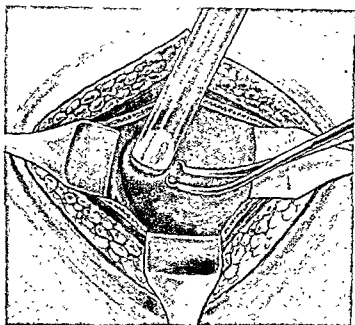


FIG. 330. Diverticulum of the bladder being turned inside out and seized with forceps. (After H. H. Young.)

several ounces of urine, which is often foul and different from the original. Cystoscopy may reveal the black opening of the cavern, and radiography,

after injecting a 10 per cent. solution of sodium bromide into the bladder, may show the accessory cavity and give a good idea of its size and shape

Treatment. Diverticula of the bladder sometimes cause no symptoms, for it is not uncommon to discover them after death from other causes, or during cystoscopy or operation for other conditions, such as enlargement of the prostate. In the latter the obstruction overshadows the mechanical result and, as a rule, the removal of the prostate is enough in these cases; if this fails to give satisfactory relief the pouch can be removed later.

When diverticulitis develops and persists in spite of the removal of obstruction of the urethra, the patient is very uncomfortable and is threatened with destruction of one or both kidneys. Therefore it is often

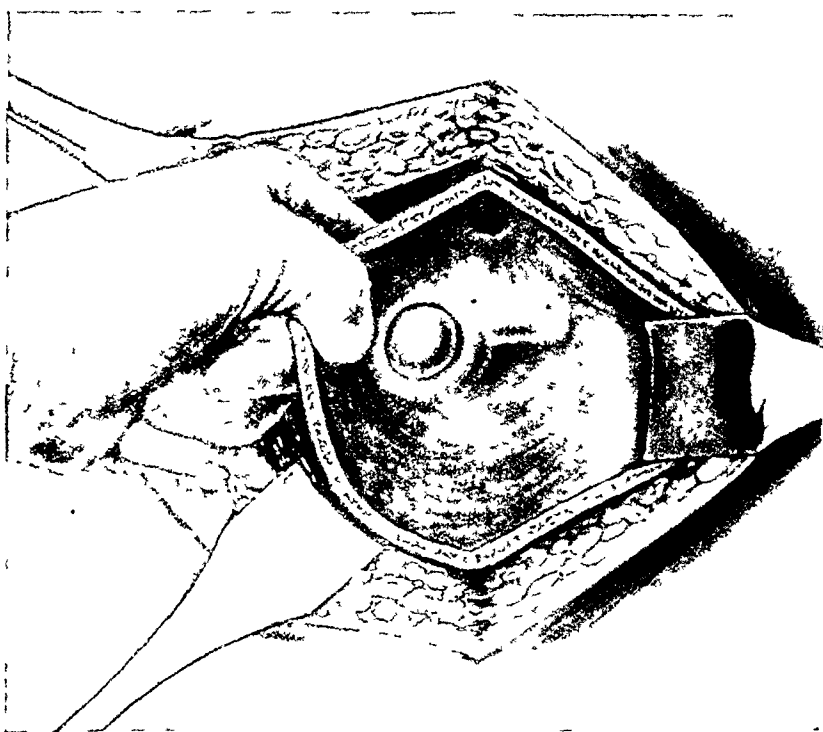


FIG 331 Excision of a diverticulum of the bladder. With a finger outside the bladder, the sac is pushed out and turned inside out (After H. H. Young)

necessary to operate. Palliative operations have not been attended with much success; whereas of the fifteen operations by excision of the sac, collected by Lerché,¹ only one died, and the functional results were on the whole good.

Palliative. Removal of the obstruction of the urethra is enough in many cases. Simple drainage of the diverticulum into the vagina or on to the skin of the abdomen has been fairly successful, but drainage behind the prostate into the perineum is not to be recommended, for urinary fistula sometimes follows. Stretching the orifice of the diverticulum is almost useless, for it soon contracts again. Free incision downwards away from the peritoneum was very successful in one of my cases. The patient,

¹ *Ann. of Surg.*, 1912, iv, 285.

who also had a very large stone removed from a large pouch to the left of the bladder followed by a prostatectomy was quite well twenty years later. But as a rule the symptoms recur. Suprapubic drainage of the bladder affords only temporary benefit but may be useful to correct cystitis and pyelonephritis before a radical operation is undertaken in bad cases. The diverticulum can be separately drained by two tubes at the same time with the result that it shrinks and becomes clean and its removal is easier and safer.

Radical Operations Although sacculi have been successfully removed by the vaginal route and a partial success has been obtained by adopting

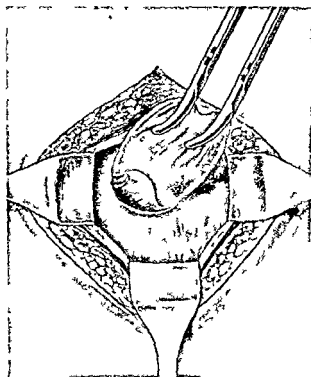


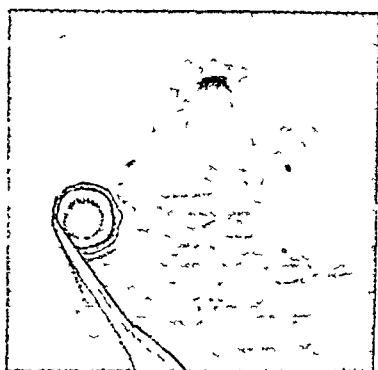
FIG. 33. Excision of a diverticulum of the bladder. The sac has been turned inside out into the bladder; its neck has been incised, displaying the left ureter. (After H. H. Young.)

the sacral route it is much better to approach the sac from the front without opening the peritoneum and best of all from within the bladder. J. Swift Jolly¹ in a valuable paper strongly recommends excision and describes fourteen cases under his care.

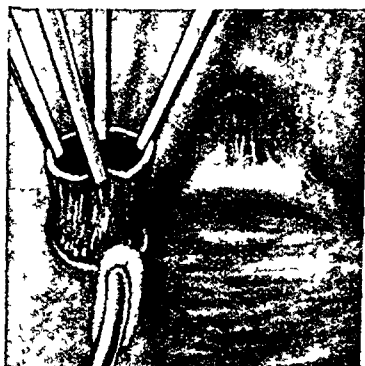
(1) **The Suprapubic Intrapertoneal Route** When the sac projects into the peritoneum from the upper and back part of the bladder it may appear necessary to open the peritoneum and a few successful operations have been carried out this way but, with a little patience, the peritoneum can be stripped off the sacculus so that the latter can be removed extra-peritoneally.

¹ *Lancet* 19.3 : 445

(2) **The Suprapubic Extraperitoneal Route.** This is much the best way of dealing with diverticula of the bladder, which are nearly always subperitoneal and often low in the pelvis. Whenever possible the diverticula are removed from within the bladder. Cystitis is treated as far as possible beforehand with urinary antiseptics and irrigation. Just before the operation the bladder is washed out and about ten ounces of boracic lotion left in. A long median suprapubic incision is made and, if necessary to obtain more room, the rectus on the same side as the sac is partly or completely divided about one inch above the pubes. The peritoneum is very freely separated from the bladder by gauze dissection and pushed up. The bladder is opened and carefully examined, after all the liquid contents have been drained away through the catheter, for there may be several sacculi. The Trendelenburg position is adopted and good vesical retractors are essential. Calculi are common in the diverticula or bladder and some are dumb-bell shaped and very difficult to remove without



A.



B.

FIG. 333 Diverticulum near the left ureter. Its neck has been divided (A): it is then drawn out with forceps and separated by blunt dissection, as in Whitehead's operation for piles (B). (After H. H. Young.)

breaking them up first. Small sacs have been successfully removed after turning them inside out by suction through glass tubes, as first recommended by H. H. Young,¹ or by introducing a pair of artery forceps through the orifice, lightly grasping the fundus of the sac and inverting it into the bladder; the neck of the sac is carefully sutured in inversion. Failing inversion a circular incision is made round the vesical orifice of the sac, the margins of which are seized with forceps so that the sac can be drawn out and separated by blunt dissection as in Whitehead's operation for piles, as recommended by Young. The safety of the ureter and blood vessels depends on keeping close to the sac; the mucous lining is the only part of the sac demanding complete removal and as a rule this strips off fairly easily even in late cases with large sacs which have been subject to chronic inflammation. Lateral incisions in the bladder at the neck of the diverticulum are often useful in giving more room. Sometimes external pressure upon the diverticulum is useful in starting inversion into the bladder. When these methods are impracticable the left forefinger is

¹ *Johns Hopkins Hosp. Reps.*, 1906, xiii, 402-446, and *Practice of Urology*, 1926, ii, 338.

passed into the sac, bringing the latter upwards and forwards while its anterior and exterior surfaces are exposed by gauze dissection in the lateral pelvic cellular tissues. Lerché¹ in one case introduced into the sac a rubber bag tied on the end of a ureteral catheter and distended this with boracic lotion. A similar bag may if necessary be introduced into the sac through the suprapubic wound but the finger generally suffices. As the posterior part of the sac is approached care must be taken with the vessels and especially with the ureter which is often adherent to the sac and sometimes discharges into it. Dense adhesions between the sac and the rectum the vas and vesiculæ seminales may be very difficult to separate. When the sac has been completely isolated its neck is divided and the mucous and muscular tissues around its neck are sewn in layers with interrupted catgut sutures. If the ureter ends

in the sac it is essential to save its valvular insertion intact by making a curved incision above the latter and taking care to bring it well within the bladder when the posterior vesical incision is closed by suture (Young). Division of the dilated ureter and sewing it to the upper angle of the posterior vesical wound is often followed by a pending suppurative nephritis. Tying the ureter and dropping it back is very bad, for this plan has been followed by death from failure of the opposite kidney or suppuration and removal of the kidney whose ureter was tied. A rubber tube inserted

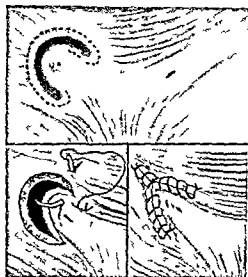


FIG. 334. Excision of a diverticulum of the bladder containing the orifice of the right ureter. Note the incision made to save the ureteral orifice. (After H. H. Young.)

extravesically is used to drain the space formerly occupied by the sac and brought out into the suprapubic wound and the bladder itself is drained suprapubically by a large tube as already described on p. 603. It is not wise to close the bladder completely as there is nearly always a good deal of cystitis, and drainage by catheter through the urethra is not satisfactory. In several cases secondary perineal drainage of the bladder had to be adopted. It is better, therefore, to drain the bladder suprapubically from the first and not to submit the sutured neck of the sac to undue pressure. After about four days the tubes are removed and the wound is allowed to heal.

As a result of the chronic irritation of cystitis or calculus carcinoma of the bladder is a common complication in these cases, it may occur at the orifice inside the diverticulum or in the bladder itself. This complication was found in ten out of 133 cases at the Mayo Clinic. In most cases

the carcinoma can be removed at the same time as the diverticulum, but the prognosis, both as regards the immediate and ultimate results, is not good.

Results. In a valuable contribution, E. S. Judd and A. J. Scholl¹ gave the results of the surgical treatment of 133 cases of diverticula of the bladder at the Mayo Clinic. "The diverticula were completely excised in fifty cases. Three patients, 6 per cent., died. In thirty-seven cases in which there was obstruction of the vesical outlet the diverticulum was excised, and prostatectomy performed. Three patients died (8.1 per cent.). In forty-six cases the diverticulum was not removed."

VESICAL FISTULÆ

Vesical fistulæ sometimes follow operations, injuries or diseases, such as suprapubic or vaginal cystotomy, rupture of the bladder, the rupture

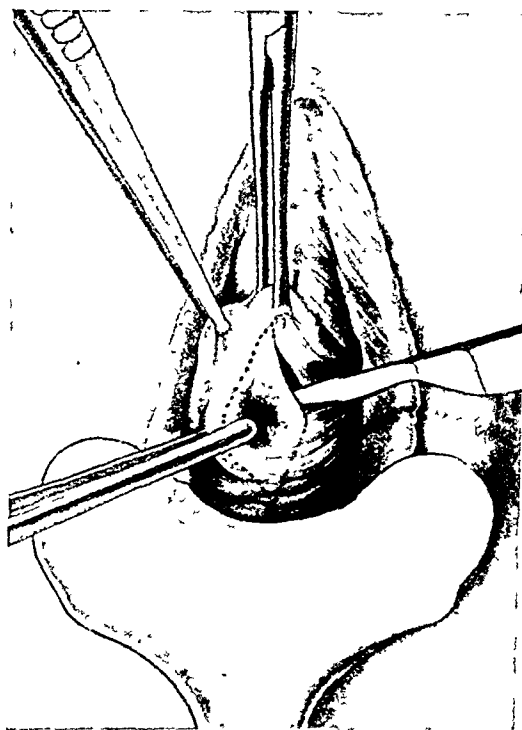


FIG. 335. Operation for vesico-vaginal fistula; the margins are excised from the vagina. (After E. S. Judd.)

of an intestinal abscess into the bladder or the invasion of the latter by an ulcerative new growth of the bowel. These fistulæ may be conveniently divided into suprapubic, vaginal and intestinal.

Suprapubic Vesical Fistula. When such a fistula becomes chronic from long-continued drainage or from errors of technic, it becomes lined with epithelium or callous granulation tissue, and the bladder becomes so adherent to the parietes that the retraction and mobility that are necessary for closure cannot take place. When any urethral obstruction has been overcome with cauterising or scraping the fistula has failed, an operation becomes necessary.

¹ *Collected Papers of the Mayo Clinic*, 1923, xv, 467.

Operation An elliptical incision is made around and $\frac{1}{2}$ inch away from the fistula which is carefully separated from the rectus sheath and muscles these are well displayed and defined and the fistulous track is traced down to the bladder and completely excised. Sometimes a probe inserted in the fistula is useful as a guide. The anterior wall of the bladder is well separated from the pubis and abdominal wall and the peritoneum is pushed up if necessary. A soft catheter (No 12) is passed along the urethra to prove the passage clear and to drain the bladder. The opening into the bladder is closed by one or more Connell sutures which turn in the edges further inversion is obtained by Lembert or Cushing sutures.

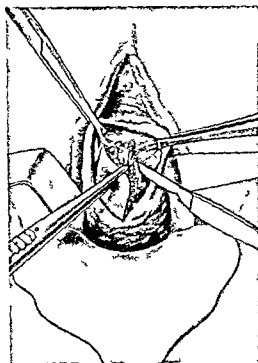


FIG 336 Operation for vesico-vaginal fistula the elliptical incision around it is carried through into the bladder (After F S Judd)

The catheter is tied in for ten days or until the fistula has firmly healed.

Vesico Vaginal Fistula This may follow accidents difficult labour and operations such as vaginal lithotomy and hysterectomy. It is a terrible affliction which is difficult to cure repeated operation having failed in some cases.

It is necessary to excise the fistula to sever the resulting vaginal and vesical wounds separately and accurately and to fix in a catheter to drain the bladder until the wound has healed. As a rule it is better to excise the fistula from the vagina rather than through a suprapubic cystostomy which adds another wound and possible fistula.

Operation The lithotomy position and a good speculum and retractors are necessary. A catheter is passed through the urethra into the

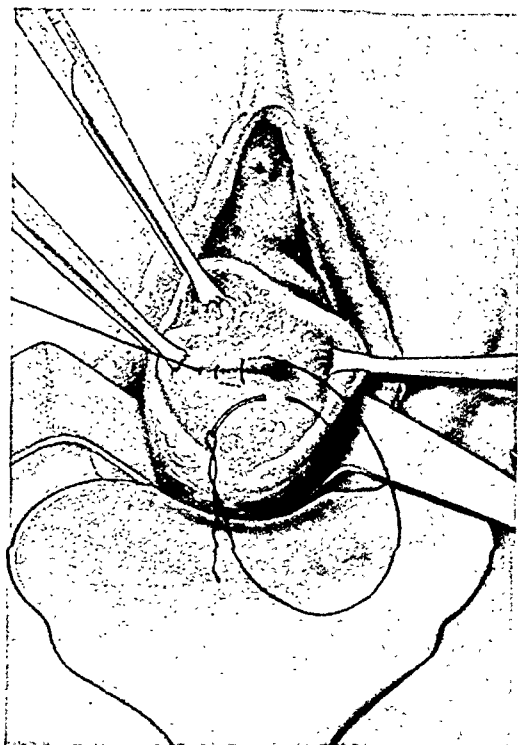


FIG. 337. Operation for vesico-vaginal fistula. The deep catgut suture is so passed that it turns in the vesical mucosa and secures wide apposition.

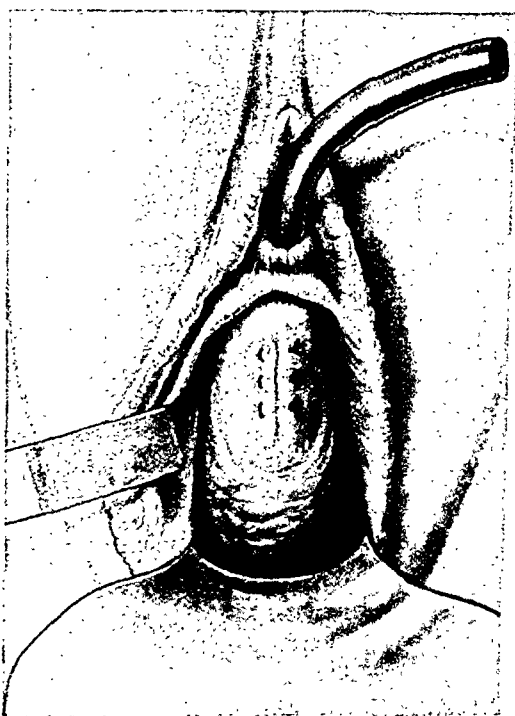


FIG. 338. Operation for vesico-vaginal fistula completed. Mattress sutures evert and secure wide apposition of the vaginal mucosa.

bladder as a guide. An elliptical incision is made around and half an inch away from the vaginal orifice of the fistula. The wound is gradually deepened and the bladder is separated from the vagina. The edges of the opening into the bladder are pared but this opening must be kept as small as possible. It is closed with one or more Connell's catgut sutures which invert its edges (Fig. 337). The much larger vaginal wound is then closed with interrupted catgut mattress sutures which turn out the edges thus securing wide apposition (Fig. 338). A soft self-retaining catheter is kept in for a fortnight or until the fistula has closed.

The suprapubic operation demands the high Trendelenburg position, good vesical retractors, a head light and long handled malleable needles. The fistula is excised and the wounds closed as already described.

Vesico-Intestinal Fistula. This is very troublesome, painful and dangerous because it nearly always causes severe infection of the bladder and kidneys with high fever, rapid wasting and anæmia. The commonest variety is that due to diverticulitis of the pelvic colon. Malignant disease is a much rarer cause of such a fistula.

Colostomy with complete diversion of the intestinal contents is invaluable in these cases and may be followed by the natural closing of the fistula. A laparotomy is necessary in some cases to separate the bowel from the bladder and to close the resulting openings into the bladder and bowel.

OPERATIONS UPON THE TRIGONE

The trigone sometimes inflames or hypertrophies and thickens and causes obstruction of the vesical orifice. Its posterior edge may thicken into a prominent ridge or bar extending between the two ureteral orifices. Behind this bar a deep pool forms and the bar may flap forwards over the vesical orifice and thus cause partial or complete obstruction. This condition is often associated with enlargement of the prostate and may cause incomplete recovery of the power of emptying the bladder after enucleation of the prostate. It may also occur independently of any enlargement of the prostate.

H. H. Young¹ and others have described this condition. The best treatment is removal of a wedge from the middle of the bar thus bringing the bottom of the pool behind it to the level of the orifice and completely overcoming the obstruction (see Figs. 339 and 340).

ECTOPIA VESICÆ

Although a few of these patients (whose condition in spite of apparatus is truly pitiable) reach adult life and can manage to earn their living, most of them die of ascending nephritis and intercurrent disease before they reach puberty. On the other hand I saw one man aged twenty-five who earned his living as an optician and managed to keep himself clean and without smell by wearing large thick bath towels as diapers. The towels were frequently changed and immediately washed before the urine decomposed.

The various methods adopted for the relief of this terrible affliction

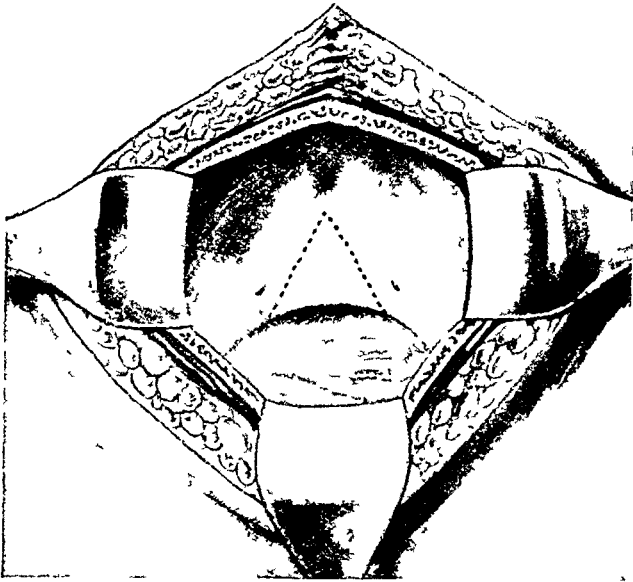


FIG. 339. Removal of trigonal bar obstructing the exit from the bladder.
The wedge indicated is excised from the bar or flap (After H. H. Young.)

may be divided into three main groups : (1) the construction of a bladder, (2) the transplantation of the ureters into the urethra or elsewhere, and (3) the diversion of the urine into the bowel.

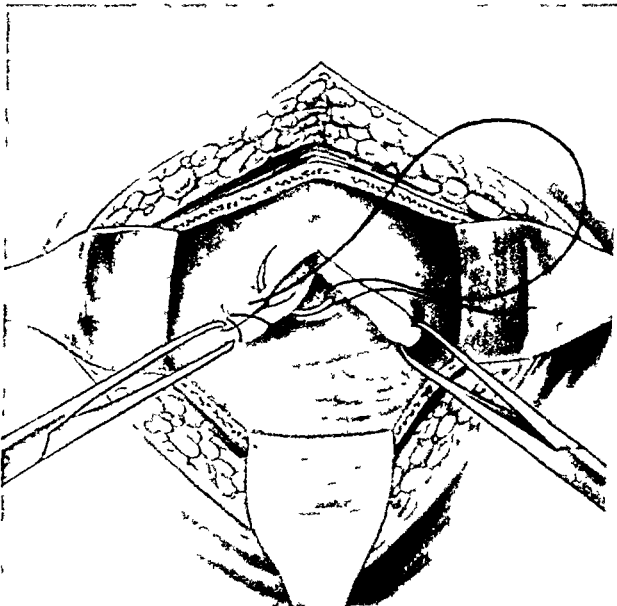


FIG. 340. Removal of trigonal bar or flap which had caused retention of urine.
Suture of edges of resulting wound (After H. H. Young.)

(1) The first group consists of plastic operations which aim at the formation of a new anterior vesical wall. Wood's method has been most widely adopted. The anterior wall of the bladder is formed by skin flaps. The advantages gained by the operation if successful are that a receptacle for the urine is formed and that the exposed mucous membrane is covered in and protected but unfortunately the most important lower part where the ureters discharge pouts and remains exposed to as much irritation as ever. Fistulæ are common even after repeated operations and then the patient is very little better off than before because the urine cannot be collected satisfactorily by a urinal. With the growth of hair into the bladder cystitis is set up and the hairs are often the seat of phosphatic deposit which has to be removed at intervals. It is important to remember that no sphincter is usually provided and therefore there is no control so that a urinal must be worn constantly as before. In a few cases however Trendelenburg has been able to control the urine by a clip and A. R. Thompson¹ by making a sphincter from the rectus abdominis. One of us² (R. P. R.) obtained perfect control in one case for many years by performing a plastic operation upon the neck of the bladder narrowing the channel and approximating the ends of the sphincters. H. H. Young³ describes a similar operation which was successful in four out of five cases.

Attempts have been made to form the new bladder of mucous membrane instead of skin but stones have formed even when the whole of the new bladder has been lined with mucous membrane either of intestinal or vesical origin.

Tizzoni and Poggi successfully removed the bladder of a dog and replaced it by a new bladder formed from a piece of small intestine which they left attached to its mesentery after having cut it out of the circuit of the alimentary canal. Rutkowski⁴ acting on this suggestion successfully made use of an intestinal flap for ectopia in a boy aged 9.

Warbasse⁵ gave an account of the operation.

(2) In the second group of operations no attempt is made either to construct a bladder or to provide an alternative and controllable receptacle but the ureters are transplanted into the urethral gutter so that the urine can be conducted more easily into a urinal. This operation is more successful than the more elaborate flap methods although it is less ambitious.

(3) In the third group of operations no attempt is made to form a bladder but the course of the urine is diverted into the bowel which thus becomes the receptacle for the urine. It is an advantage to do this extraperitoneally whenever it is possible to do so efficiently but the peritoneal route gives more room and freedom in young children.

A number of surgeons have excised the vesical mucous membrane⁶ and implanted the ureters in the rectum or sigmoid. The chief objection to

¹ *Lancet* 1909 ii 730

² R. I. Rowlands *Med. Press and Circular* 1909 cxxxvii 80

³ *Pract. of Urology* 1906 i 393

⁴ *Cent. fur Chir.* No 16 1899

⁵ *Ann. of Surg.* August, 1899

⁶ Carcinoma is very apt to develop in the exposed and irritated mucosa. C. H. Mayo and W. Walters (*Collected Papers of the Mayo Clinic* 1903, xv 501) mention three examples of this, and Dupont (*Journ. Urology* 1909 i 433) has found twelve recorded cases. Therefore it is wise to excise it.

this is the liability to infection of the ureters from the bowel, resulting in ascending nephritis. Maydl has largely overcome the risk of infection by implanting the whole trigone into the colon, thus retaining the valvular orifices of the ureters. Oblique implantation of the separate ureters has also been successful in creating a valvular protection.

OPERATIONS

(1) **The construction of a bladder.** (a) Wood's plastic method ; (b) Trendelenburg's operation ; (2) **The transplantation of the ureters into the urethra, Sonnenburg's operation.** (3) **The diversion of the urine**

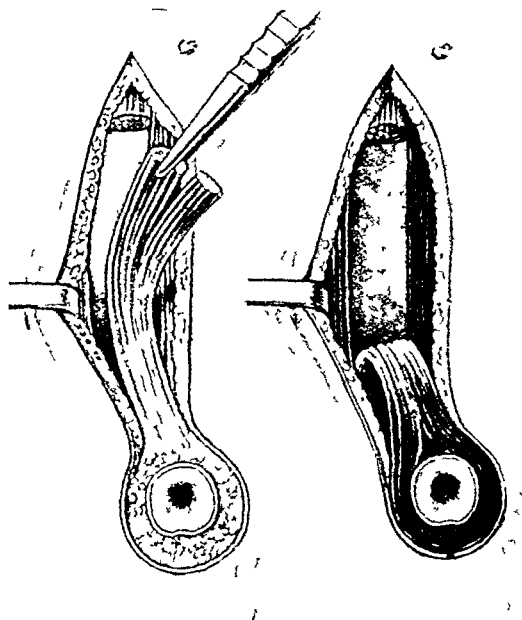


FIG. 341. Construction of a sphincter for the bladder from the rectus abdominis. A. R. Thompson's method.

into the intestine: (a) Frank's method ; (b) Maydl's method ; (c) transplantation of the ureters into the bowel ; (d) Moynihan's method. These methods have almost entirely replaced the others.

(1a) Wood's Operation.¹

Age. The cure of the ectopia may be commenced after the child is four or five and should be completed, if possible, by puberty. In this case the epispadias may be taken in hand and corrected before adolescence.

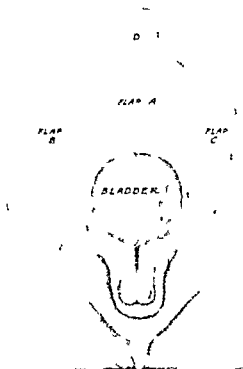
Unfavourable Conditions. 1. Large size of the ectopia, with much bleeding and some purulent discharge from the surface. 2. A sickly condition of the patient, pointing to poor powers of repair, and a waddling gait to wide separation of the pubes. 3. Tendency to cough. This increases the protrusion. 4. Presence of large herniæ. 5. Secondary

¹ *Dict. of Surg.*, i, 425, and *Med.-Chir. Trans.*, iii, 85.

dilatation of the ureters and pelves of the kidneys with degeneration of viscera Mr Wood shows that sometimes the above complication may be recognised by the presence of more albuminuria than is accounted for by the amount of cystitis 6 Obstinate eczematous rawness 7 Small size of the scrotum

Preparatory Treatment If the patient has passed puberty, and the hair is at all abundant depilation should be practised

Operation A median flap¹ is raised from the abdominal wall above the exposed bladder Its shape resembles that of the wooden portion of



Pl. 342 Wood's operation for ectopia vesicæ (Binnie). Flap A is turned down to form the anterior wall of the bladder and D may be adhed to cover the urethra Flaps B and C are displaced inwards to cover the raw surface of flap A

a fire bellows its length is rather greater than the distance between the root of the penis and the upper margin of the exposed bladder while its root must be sufficiently broad to ensure a sufficient blood supply In raising it, care must be taken not to cut it too thin and at the same time not to go too deeply with the point of the knife as the tissues here are extremely thin and the flat tense expanded linea alba beneath is often very thin and thus the peritoneal sac may easily be opened

¹ The shape and arrangement of the flaps are excellently shown in pl. ii. Figs 1 and 2 accompanying Mr Wood's paper (*Med Chir Trans* vol. liii). Some illustrations of other flaps in a paper by Mayo Robson (*Brit Med Journ* 1885 i 222) will also be found useful. I should direct my readers attention to a paper by the late Mr W. Anderson (*Clin Soc Trans*, 1892 xxv 78) which contains as might be expected, some very helpful drawings.

The two groin flaps are next made, of rounded oval shape, with broad pedicles, the outer boundary of which is sufficiently carried out on to the thigh and then on to the root of the scrotum, to ensure its containing the superficial epigastric and external pubic arteries. The inner margins of these flaps join those of the central flap at about its centre and are then continued down along the side of the urethral groove for about half its length.

While these flaps must be cut as thick as possible, care must be taken to avoid any subsequent hernia, and they must be sufficiently detached

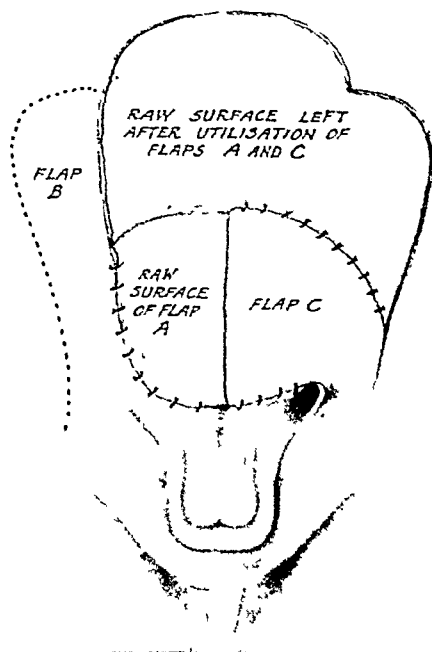


FIG. 343. Wood's operation for ectopia vesicae (Binnie). The raw surface is lessened by approximation of the edges and covered with skin-grafts.

to meet for their whole length, without tension, in the middle line. In raising them they must be handled as carefully as possible, whether with fingers or with bluntly serrated forceps, so as in no way to impair their vitality. All bleeding having been stopped, the umbilical flap is first taken and folded down, with its skin surface towards the bladder, evenly and without tension. It is then stitched with catgut to the cut edges, above the root of the penis.

The groin flaps are then drawn inwards, placed with their raw surfaces upon the raw surface of the umbilical flap and carefully stitched together with fishing-gut.

The raw surface from which the central flap was taken is then closed, as far as possible. The rest of this wound may be closed, now or later on, by skin grafting.

(16) **Trendelenburg's Operation** Prof Trendelenburg¹ published a case of extroversion of the bladder in which immediate union of the lateral margins was obtained by previous division of the sacro iliac synchondroses. By entirely freeing the joints this surgeon has gained an approximation between the anterior superior spines of two inches in a child of two and a half. This approximation is of course only rendered possible by the fact that the symphysis pubis is deficient in these cases. When the bones are thus approximated the lateral margins of the defect are pared and brought together with sutures so that the bladder shall consist of vesical mucous membrane and not of scar tissue. As a result the formation of phosphatic deposit is greatly diminished. A very interesting account of this operation has been given by Sir George Makins with a successful case.²

Prof Trendelenburg read a paper before the American Surgical Association giving his views and the instructive results of his mature experience.³ He maintains that the bilateral separation of the sacro iliac joints in children before the seventh or eighth year is not the serious procedure that some consider it to be and that it is very effectual in relieving lateral tension. He believes that transplantation of the trigone into the bowel will be again abandoned on account of the risk of pyelonephrosis and the inconvenience of micturition through the anus especially in a male.

By careful paring and re formation of the neck of the bladder and urethra he maintains that it is possible in at least some cases to obtain more or less perfect sphincteric control of the bladder or failing this to provide artificial control.

Of the cases operated upon by Trendelenburg years ago for defects extending from the umbilicus to the glans penis three are alive and without any fistulous openings but with a complete bladder and urethra. The bladder when distended consists of a spherical cavity lined with mucous membrane over its greater extent. The passage of small concretions is occasionally observed by these patients but the tendency to calculus formation is by no means as marked as in certain cases operated upon by Thiersch (flap method) which I have had occasion to examine.

These patients partly suffered to such an extent from the production of calculi incrustations and ulcerations in the irregular crypts of the bladder that they demanded operation by some other method for the relief of their condition.

Retention of urine is not complete in any of my three cases. These young men therefore wear a contrivance supplied with a small spring which compresses the urethra at the root of the penis either from the front or the back. The patients are now students at college, they are not greatly inconvenienced by the apparatus and by proper care and attention they avoid the production of any odour which would serve to attract attention to their condition. If the spring is raised the urine issues forth in a stream. On lying down it collects in the bladder with out leakage. One of the men remains dry throughout the night, he may be awakened once or twice by the desire to urinate and even when he

¹ *Centr J Chir* No 49 December 1885

² *Trans Med Chir Soc* 1888 lxxi 191

³ *Ann of Surg* 1906 xliii 281

gets up he can voluntarily retain the urine for several minutes, and then pass it naturally in a stream. A fourth patient, a boy of five, could also, when he tried, retain his urine for several hours when standing or walking, but later on at the time of his leaving the clinic the ability was lost.

"Both of the two cases last mentioned demonstrate that physiological factors necessary for both retention and voluntary micturition are present, and that they are merely prevented from functioning in a normal manner by certain mechanical conditions. The reason for the failure may be accounted for by the fact that the two sections of the pelvis, which have been separated at the sacro-iliac synchondrosis, have a tendency gradually to resume their former positions; therefore the neck of the bladder and the prostatic portions of the urethra, which are closely connected with the pubic bones, are pulled upon to such an extent that the muscular ring can no longer be brought into play.

"I have made several attempts to overcome this difficulty by mobilising the pubic bones, with the help of the chisel, or by dissecting widely the attachments of the urethra and the neck of the bladder to the latter. In no instance of complete ectopia have I been favoured, however, with a permanent result. Such procedure, moreover, is apt to lead to the production of a dense scar along the vesical neck, which in the event of a late secondary operation will be found a source of as great annoyance as the cicatrices in a hare-lip which has failed to heal by primary union."

Cases of partial ectopia or of epispadias and incontinence are more favourable, and Prof. Trendelenburg has been able to obtain excellent results in a few of these by paring freely enough and carefully suturing the vivified edges of the urethral groove or deficiency in the lower part of the bladder. The margins of the vesical part of the wound are inverted. During these procedures the pubic bones are strongly retracted, and the pelvis is elevated. Only a fine drainage-tube is left in the newly completed urethra, for a catheter might exert too much pressure on the sutured tissues. The bladder is drained through a special opening until healing has occurred.

In the case of a female child with epispadias and incontinence, Prof. Trendelenburg was able to suture the pubic bones together after separating the right sacro-iliac joint and suturing the urethra and neck of the bladder. Success did not attend the operation, which was therefore repeated. This time the result was good, and it remained perfectly satisfactory six years later.

It is rarely possible to complete the pubic arch in cases of extensive ectopia, and "wiring of the bones, particularly in boys, cannot be advantageously employed, because the wire comes in conflict with both the bladder and the penis. In younger children, moreover, the wire is very apt to cut its way through the tissues."¹

Trendelenburg believes that this approximation can be best accomplished by the gradual effect of pressure by means of an elastic pelvic girdle worn day and night. This method is most likely to be successful when adopted after separation of the bones at both sacro-iliac joints. When the pubic gap has been greatly diminished, a plastic operation can be undertaken for reconstructing a bladder and urethra.

It may be safely concluded, I think, that the results of Prof. Trende-

¹ Trendelenburg, *loc. cit.*

lenburg are as good as any that can be obtained by any plastic method but the functional results are not encouraging except in cases of partial ectopia and epispadias with incontinence. The mortality of this operation is about 20 per cent.

König has lessened lateral tension by dividing the ramus of the pubis and ischium, and Schlangé has adopted a similar method.

Segond has liberated the upper part of the bladder without opening the peritoneum and brought it downwards as a flap, and sewn it to the refreshed lateral margins of the urethral gutter and sides of the trigone. He then made a transverse incision through the base of the pendulous prepuce and brought the penis through this aperture. The prepuce was then used to cover the raw surface of the flap on the dorsum of the penis. After this operation the urine can be more easily collected and conducted into a suitable urinal.

(2) **Sonnenburg's Operation** consists in transposition of the ureteral ends into the upper end of the gutter which represents the urethra. The rest of the vesical mucosa is resected without opening the peritoneum. A suitable urinal can be worn after this procedure with comparative ease. The gap in the parietes can be closed either completely or in part by the appropriate use of flaps. It is less dangerous, but also far less satisfactory, than Maydl's method.

(3a) **Anastomosis of the Bladder and Rectum.** Frank¹ made an incision in the posterior wall of the bladder and anastomosed the bladder and rectum by means of his absorbable coupler. He then freed the edges of the bladder, turned them in and sutured them together. Dr Halstead freed and turned in the thick mucous membrane only leaving the fascia behind so that the peritoneum was not opened.

This plan is not so satisfactory as direct implantation of the trigone into the bowel for the attempt to preserve and close the ectopic bladder is attended with more frequent failure or formation of fistulæ which may discharge either urine alone or feces also. It is probable also that calculi will form in the vesical diverticulum which communicates with the rectum unless the fistula is a wide one.

Further it is not necessary to save the whole of the bladder for the rectum soon affords plenty of room for the urine.

(b) **Maydl's Operation**² **Transplantation of the Trigone into the Pelvic Colon.** After sewing in catheters in the ureters an incision is made at the junction of the mucous membrane of the bladder and the skin all round it. The wound is carried through the bladder wall at its upper end and a flap of bladder is drawn downwards and forwards while it is separated from the abdominal wall from above downwards. The peritoneum is separated above and opened lower down. As the dissection approaches the base of the bladder there is free bleeding and the ureters are in danger, but with the aid of the catheter in them they are saved from injury and freed but not bared for about an inch above their insertion at the trigone.

When the whole bladder is detached the greater part is cut away, leaving an oval piece with its long axis transverse, including the trigone and ureteral orifices, and extending half an inch above and outside these

¹ *Ann of Surg* 1903 xxxvii 291

² *Wien Med Woch* 1894

openings; more of the mucosa is removed than of the outer coats. The catheters are removed.

A loop of pelvic colon is now drawn through the wound, emptied and clamped, and the abdominal cavity protected by gauze packing. A longitudinal incision of the required length is next made in the right side of the exposed loop of bowel. The trigone is now rotated so that its mucous surface faces backwards and to the left, and the left ureter is below the right one. It is joined to the margins of the openings in the colon by means of two continuous sutures of fine catgut, one piercing all the coats and the other the sero-muscular coats. The colon is cleansed and dropped well back into the abdomen, and the wound is closed in layers. In some cases it is necessary to turn in flaps of rectus sheaths with their hinges

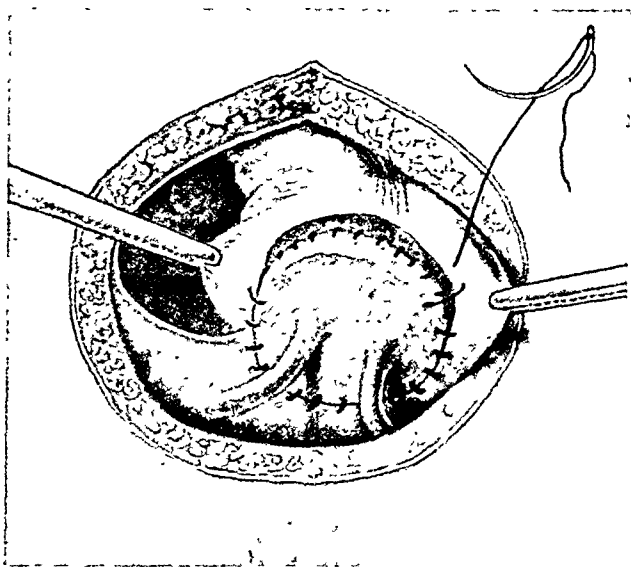


FIG. 344. Maydl's operation. (After Thomson-Walker). The oval piece of bladder is implanted into the pelvic colon.

over the inner borders of these muscles. A rectal tube is passed just above the sphincter ani and left in for three or four days to prevent over-distension of the rectum.

Maydl considers the pelvic colon to be preferable to the rectum for implanting the trigone, because he believes the risk of ascending infection to be less. Leakage is far less likely when the peritoneal-covered colon is used.

Results. Brandsford Lewis,¹ in a review of this subject, quotes the results of seventeen operations by Maydl's method, collected by Nové-Josserand. There were two deaths, one from shock and the other from infection. "The secondary accidents noted were fistulae of the urinary passages with an accompanying localised peritonitis, all of which cases recovered. Pylonephritis, as the result of ascending infection, resulted

¹ *Ann. of Surg.*, June, 1900,

in the death of one case after a period of four months. Urinary continence was perfect in all the cases excepting two. The patients were able to hold their urine for at least three hours, sometimes six or seven hours, and in one case throughout the night. The urine was voided sometimes mixed with fecal matter, sometimes alone. The tolerance of the rectal membrane was perfect."

Dr Watson¹ collected forty-two cases of Maydl's operation, and found that nine deaths had occurred (mortality 21 per cent) and that three of the deaths were attributable to the rectal unplantation *per se*.

Dr Hartley² refers to forty-six cases with a mortality of 15 per cent.

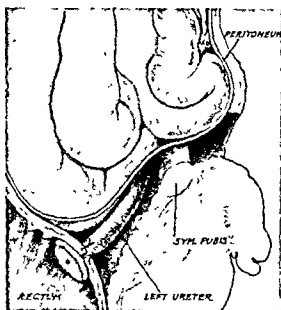


FIG 345 Ectopia vesicæ. Transplantation of the ureteral end and a small piece of the bladder into the rectum subperitoneally. (After H. H. Young.)

Orloff³ collected fifty-six cases, with eleven deaths (mortality 17 per cent) within twenty-one days.

At the Mayo Clinic⁴ the mortality of thirty-six operations was just under 20 per cent.

Although the danger of death from ascending septic infection of the kidneys is very much less than with direct implantation of the ureters without preservation of their valvular orifices, yet the risk is a real and considerable one. Some of the patients have died from this cause within a few weeks, and others after one or more years. The dangers of shock and peritonitis are also considerable, for the operation is a long and difficult one.

Four of the deaths in Orloff's collection were due to peritonitis, two to

¹ *Ann. of Surg.*, 1905, xlii, 813.

² *Med. News*, August 29, 1907.

³ *Ann. de Med. de Gen. Urin.*, No. 11, 1902.

⁴ *Surg., Gynec. and Obst.*, 1922, xxxiv, 242.

pneumonia, one to the anæsthetic and one to hæmorrhage. Of the forty-five who survived the operation five died later from ascending infection. Of Orloff's own four cases one died from this cause in a fortnight, and another after two years. It is fair to state, however, that a number of these patients were already suffering from more or less renal changes at the time of the operation.

Function. The rule is that the rectum gradually, or even rapidly, acquires the power of retaining the urine for several hours without any



FIG. 346. Ectopia vesicæ. The ureters have been transplanted subperitoneally into the rectum. (After H. H. Young.)

appreciable sign of irritation. During the day the control is almost perfect, but incontinence or reflex evacuation is not uncommon at night.

(c) **Transplantation of the Ureter into the Bowel.** Dr. Peters,¹ of Montreal, successfully transplanted the ureters into the rectum extra-peritoneally. The patient was six years of age at the time when Dr. Peters recorded the case. The urine could be retained in the rectum for three hours during the day and for eight hours during the night. His method may be quickly done in the following simple way :

A catheter is passed into each ureter and sewn in, and the lower inch of the ureter is isolated ; a fine curved sinus forceps is passed into the clean rectum and forced obliquely forwards into the wound below the ureter, where it grasps the catheter and draws it and the ureter into the

¹ *Brit. Med. Journ.*, June 22, 1901.

rectum. A couple of sutures close the small wounds in the bladder. When the operation has been completed the two ureteral catheters project from the anus. They loosen and come away within a week. Bergenheim saves the valvular orifice of each ureter and transplants this into the rectum extra peritoneally. L. H. and A. Hutchins¹ recommend this method (Figs 345 and 346).

C. H. Mayo and W. Walters² describe their method of transplantation of the ureters into the bowel, and give the end results in 35 cases of exstrophy of the bladder seen at the Mayo Clinic between February 1912, and November, 1921. They apply Coffey's principles of common bile-duct implantation, the ureter lying in the submucous tissue for 3 cm. before it pierces the mucosa, thus creating a valve to prevent the ascent of gases and liquids with ascending nephritis. They implant the ureters into the recto sigmoid intra peritoneally one at a time with an interval of a fortnight. The results were good in 28 cases, where both ureters were transplanted, with one death from peritonitis, four others died within three years from pneumonia enterica, tuberculosis and carcinoma of the bladder. The functional results were good although the control of the urine was imperfect in some cases.

R. C. Coffey³ when diverting the urine before cystectomy, for carcinoma, transplants both ureters at the same time leading them for some distance under the mucous membrane of the bowel, but he sews catheters in the ureters to prevent the temporary obstruction which has been so often fatal. The catheters are brought out through the anus and come away after some days. The method is applicable to ectopia vesicæ, but is neither so simple nor so safe as Maydl's operation.

(d) **Transplantation of the Ectopic Bladder into the Wall of the Rectum.** Sir Berkeley Moynihan successfully⁴ transplanted nearly the whole of the ectopic bladder into the rectum of a young man, aged 19. A plastic operation had been performed fifteen years earlier, but the lower part of the vesical mucosa was still exposed, and the urine was dis-

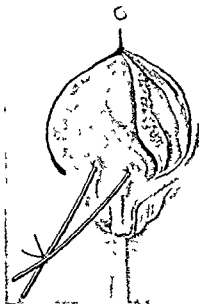


FIG 347 Moynihan's method of transplanting the ectopic bladder into the anterior wall of the rectum. The bladder is carefully liberated without opening the peritoneum. The ureteral catheters are fixed in position by sutures.

¹ *Surg., Gynec. and Obst.*, 1923, xxxvi, 731.

² *Collected Papers of the Mayo Clinic*, 1923, xv, 498.

³ *North West Medicine*, May, 1925, and a personal communication.

⁴ *Ann. of Surg.*, 1906, xliii, 237.

charged upon the exposed surface. It was there caught in the usual rubber receptacle, of pestilent odour, and drained downwards to the leg. The patient, with increasing years, had become more painfully aware of the misery of his condition and begged to have something, anything, done to relieve him of his terrible affliction."

It occurred to Moynihan that "if a large area of the bladder could be grafted, so to speak, into the rectum, the capacity of the bowel would be increased and a veritable cloaca formed. My only doubt was that the vascular supply furnished along the ureters might be insufficient for a large area of the bladder. But in the operation I now describe I found

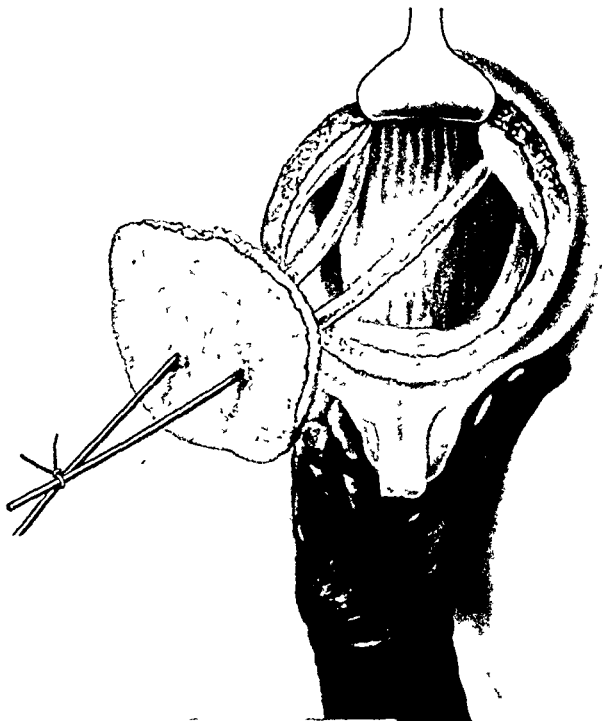


FIG. 348. Moynihan's method of transplanting the ectopic bladder into the anterior wall of the rectum. The ureters are not separated nearly so freely as shown in the figure.

that when the edges of the bladder were trimmed with scissors a free oozing of blood occurred from the cut surface. I therefore was able to transplant the entire bladder."

Operation. "The ureters were first catheterised. Owing to the previous constant friction against the exposed bladder mucosa, which pouted exuberantly, this little manœuvre was by no means easy. A catheter was passed for four inches into each ureter and was fixed there by a single stitch, which caught up the tube on one side and the bladder on the other.

"A vertical median incision was then made from the exposed bladder mucosa towards the umbilicus, the flaps which had been turned over to the middle line in the previous operations being completely cut through. On turning aside the flaps thus made the upper previously covered

mucous surface of the bladder was exposed, it was found to be smooth, thin and entirely different in character and appearance from that of the lower exposed part. An incision all round the margin of the mucous membrane of the bladder was now made between the mucosa and the skin, and the incision was deepened by degrees until a good thickness of the bladder could be raised up.

"The dissection from the margin of the bladder towards the ureters was continued round the whole circumference little by little. This was

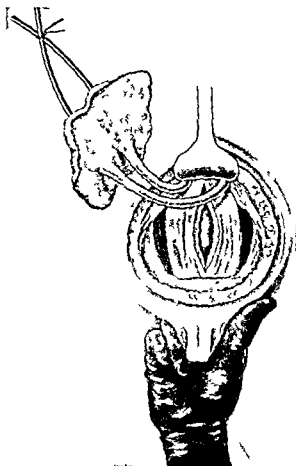


FIG. 349. Moynihan's method of transplanting the ectopic bladder into the anterior wall of the rectum.

difficult in part owing to the fact that there was much scar tissue left from the former operations in part because the great vascularity demanded frequent cessation to restrain hæmorrhage by pressure. The separation above the pubes was most difficult and here the prostate had to be separated with great care.

"The purpose of this process of separation was to isolate the whole of the bladder, leaving only as its pedicle, so to speak, the two ureters. As much tissue was left round each ureter as possible so as to avoid the possibility of damage either to the ureter itself or to its vessels. In

the annexed diagram (Fig. 348) the ureters are shown clearly defined. This was not their condition during the operation. The figure is drawn only for the purpose of making the details of the operation clear. As soon as the bladder was well isolated, it was drawn forwards towards the umbilicus and there held by an assistant. In the bottom of the wound the rectum was now seen, and above the peritoneal reflection on to it. The serous covering was then stripped upwards from the front of the rectum until four or five inches of the bowel lay exposed at the

bottom of the wound. In stripping the peritoneum up a small rent was made into it, which was closed at once by a continuous catgut suture.

"The finger of an assistant was now passed into the rectum to make it prominent, and along the anterior surface of the bowel an incision about three and a half inches in length was made (Fig. 349).

"The upper and lower ends of this incision and the mid points of the sides were held with small vulsella, until a large opening was made. Into this opening the bladder was placed, being turned upside down, so that its former anterior surface became posterior, and its former lower end became the upper.

"The ureters, instead of passing forward to the bladder, passed backward, and the catheters passed into the rectum and out at the anus. The edge of the bladder and the cut edges of the rectum were now sutured together by two stitches that were continuous, one taking the right side and the other the left

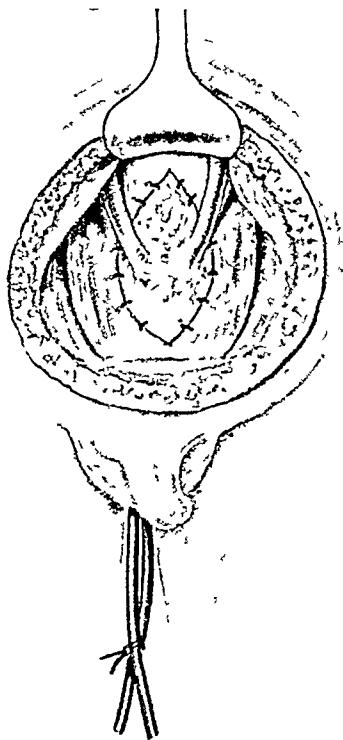


FIG 350. Moynihan's method of transplanting the ectopic bladder into the anterior wall of the rectum. The bladder has been rotated so that its upper end is now lowest and fixed to the lower part of the wound in the rectum. The ureteral catheters are brought out through the anus.

(Fig. 350). The sutures were passed after the manner of Lembert, so that no mucous membrane was included in them. A few additional interrupted sutures were necessary here and there. When the sutures seemed to be securely uniting the bladder and the rectum, the wound was dried, and the skin edges along the original median incision were drawn together. At the upper end the edges came well into apposition, but about an inch at the lower part had to be left open. The catheter which had been introduced into the ureters now passed out of the anus; the sphincter had previously been stretched. The operation lasted an hour and a half. The after-progress of the case was satisfactory. The catheters remained in the ureters for four days, the urine being collected

into a bottle. After their removal the urine passed into the rectum and dribbled out at the anus which, owing to the stretching of the sphincter, as yet exerted no control. On the seventh day a little urine began to leak by the abdominal wound and this continued for a week. On the fifteenth day an anæsthetic was again administered, and the leaking point in the former line of suture discovered and made good. From this day the wound remained absolutely dry, all urine escaped by the rectum and control gradually returned, until at the end of the month it was perfect. Urine was then passed by the rectum about every two hours. The interval between the acts of emptying the rectum has gradually increased until now (November, 1905) the shortest period is three hours and the longest five hours. The urine is quite sweet and is normal on examination.

"When the rectum is now examined the line of junction between the mucous membrane of what was the bladder and the mucous membrane of the rectum cannot be distinguished. All feels smooth and even and continuous. There is a fairly capacious cloaca."

In February, 1907 Sir Berkeley Moynihan very kindly sent me a letter which he had just received from the medical attendant Dr Empey. The following is an extract from the letter: "He is following the occupation of weaving and presents the appearance of possessing excellent health. There is slight suppuration of the wound in front still going on, but nothing of importance. He requires to empty the rectum four or five times in the twenty four hours. The longest interval, I am given to understand, is from three to four hours during the day. He very occasionally wets the bed a little."

CHAPTER XXV

OPERATIONS FOR DISEASES OF THE PROSTATE

ADENOMATOUS ENLARGEMENT. MALIGNANT DISEASE. PROSTATIC ABSCESS. PROSTATIC CALCULI

ENLARGEMENT OF THE PROSTATE—ANATOMICAL AND PATHOLOGICAL CONSIDERATIONS

THE human prostate is formed by the fusion of bilateral accessory sexual glands, which remain separate in lower animals. The normal organ weighs $4\frac{1}{2}$ drachms, but it is subject to considerable variation, and prostates weighing as little as 2 or as much as 6 drachms may be quite normal. As a rule obstruction does not arise until the gland is much larger than this, but occasionally small enlargements, especially of the hard or fibroid type, with adenomatous vesical projection or flap, may make a patient entirely dependent upon a catheter, the fibroid contraction, with or without local outgrowths into the urethra, serving to interfere very seriously with the size and shape of the passage.

The effect of any enlargement also depends very largely upon the rigidity or laxity of the fascial sheath of the prostate and upon the presence of any local outgrowths into the urethra or bladder.

Prostates weighing no more than half an ounce have caused complete and permanent obstruction, while in others the obstruction has not become serious until the soft gland has reached enormous dimensions and has attained the weight of 5 or 6 or even more ounces. Sir J. Thomson-Walker¹ removed one weighing 24 ounces.

It is important to remember that the prostate is (1) enclosed within a *true fibro-muscular capsule*, and (2) surrounded by an *external fibrous sheath* derived from the pelvic fascia (*see* Fig. 351).

(1) In the normal condition the capsule is intimately attached to the gland, so that it is practically impossible to enucleate the latter from within this covering. In the enlarged prostate, however, things are very different, for a laminated and thicker pathological capsule now surrounds the adenomatous gland. This is derived from the fibro-muscular tissue and other parts of the prostate, which have not taken a share in the adenomatous change and have become displaced outwards by the growth, as pointed out by Sir Cuthbert Wallace.²

The enlarged prostate is enucleated from within this pathological capsule, or the separation takes place between some of the laminae, so

¹ *Brit. Journ. Surg.*, 1920, vii, 526.

² *Trans. Path. Soc.*, 1905, lvi, Part I.; and *Practitioner*, September, 1905.

that thin layers of fibres are often seen encircling the prostate when the latter is properly removed in one piece. Very little bleeding need occur when the pathological capsule has formed and when the operator keeps within the proper layers.

(2) The fibrous sheath is derived from the pelvic fascia. The external layers of this are very dense, but towards its inner surface it is less firm and harbours the prostatic plexus of veins.

As pointed out years ago by Sir Henry Thompson, there is no such thing as an anatomical or physiological middle lobe, it is a pathological product, and is generally, if not always, a process derived from one or both of the lateral lobes. The vesical projection is usually most evident just behind the vesical orifice of the urethra, and in the middle line, because of the directing influence of the muscular bands which extend down to the urethra from the ureteral ends, as pointed out by Sir J. Thomson Walker.¹

The fact that the so-called median lobe is merely a prolongation from the lateral lobes is of the highest significance, for it is clear that removal of the vesical projection is not likely to grant permanent relief, for the prostate, which has produced an offshoot, is more than likely to go on growing and to obstruct the urethra by lateral compression sooner or later. Below, the fascial sheath is attached around the urethra to the triangular ligament, which offers a strong and impassable barrier to the enlarging gland, which therefore projects upwards towards the base of the bladder where the sheath is incomplete. Submucous processes therefore project upwards, by the side of the vesical orifice, and between this and the circular fibres which surround it and constrict the base of the vesical projection, so that the greatly enlarged prostate often assumes the shape of an hour glass. It is probable that the fibrous ring formed by the attachment of the lateral and anterior true ligaments of the bladder to the neck of the latter also exercises an influence in the same direction upon the shape of the enlarged prostate. From near the vesical neck the true ligaments become reflected downwards to form the dense fibrous sheath of the prostate, and upwards in a thinner layer which becomes lost upon the bladder, to the lower part of which it forms a fibrous covering. When the enlarged prostate is enucleated, the separation should always take place within the fibrous sheath, and also within at least a part of the pathological capsule. In this way the prostatic plexus of veins is not opened, and the risks of severe hæmorrhage and phlebitis are minimised. The pelvic cellular tissues are not opened, so that cellulitis of the delicate and loose tissues which surround the bladder and the other pelvic viscera should not occur if the operation is properly conducted well within the fibrous sheath. This tissue is, however, opened in exposing the bladder in the suprapubic operation, and in the perineal operation it is also traversed between the bladder and rectum. Fortunately no harm arises in the great majority of cases because of the free drainage which is provided in both operations, opportunity for extravasation into the loose tissues is therefore rarely afforded.

In some cases, however, the true or the ill-developed pathological capsule may be so adherent that enucleation is difficult, but more com-

¹ *Med Chir Trans*, 1904, lxxxvii, 404

monly an inexperienced surgeon performing the suprapubic operation may fail to find the proper layer for separation, and then he will either effect an incomplete removal of the prostate, or, on the other hand, he may tear or cut through the fibrous sheath and invade the loose pelvic cellular tissues. The one mistake is liable to be followed by a stricture or recurrence of the enlargement, while the other may result in severe hæmorrhage from the prostatic plexus or in disastrous pelvic cellulitis. It is of supreme importance to commence the enucleation between the proper layers, and in order to do this the mucous membrane of the bladder must be opened over the prominence of the vesical projection, where the prostate is covered only by mucous membrane. Generally the incision can be most advantageously made a little behind the urethral orifice, upon the so-called median lobe. When this does not exist, the opening may be made over a lateral projection; an opening made from the prostatic urethra leaves too much flap behind the internal meatus.

Indications for Operation. The ideal conditions for operation are—
 (1) A prostate moderately but not hugely enlarged—one that has loosened within its coverings by the separating action of the enlargement. Very greatly enlarged glands are difficult to remove even suprapubically because of impaction in the pelvis, and the difficulties of the perineal operation under these circumstances are still greater. If the prostate is soft and movable on rectal palpation, carcinoma is extremely unlikely, although microscopic examination not uncommonly reveals early carcinoma in an adenomatous prostate. If the prostate is as large as a Tangerine orange it will probably shell out well. A very slightly enlarged prostate does not separate nearly so well, except when suprapubically it sends distinct protrusions into the bladder as shown by cystoscopic examination.

(2) Above all, the absence of renal sepsis and degeneration from backward pressure and other causes. The operation should be undertaken, if possible, before the output of urea has been seriously diminished by long-continued obstruction and secondary fibroid changes in the kidneys, and especially before the development of cystitis, pyelitis or ascending nephritis.

(3) The absence of signs of malignant growth of the prostate or bladder. There is considerable evidence to show that the adenomatous prostate is more liable than is a normal one to become malignant, possibly as a result of the chronic irritation associated with it or with catheter life.

(4) The absence of much impairment of the general health and of serious disease of the vital organs.

To get the great advantages of operating under these favourable conditions as far as possible it is best to operate before the obstruction is sufficient to need the habitual or even the occasional use of a catheter for its relief, for, apart from exceptional circumstances, catheter life is bound to lead sooner or later to cystitis and ascending septic changes, which may either terminate the life of the patient from septicæmia within a few days or may subside for a time only to be repeated again and again, until the chances of surviving an operation and of a complete local relief and recovery of the general health are very materially diminished.¹ It is best of all to operate before the residual urine becomes more than about 2 or 3 oz.

¹ Kenneth Walker lays stress on the dangers of catheter life as compared with those of prostatectomy (*Practitioner*, May, 1924, p. 278).

Residual urine is very apt to become foul either from infection by a catheter or from the rectum. The degree of disability in micturition and the amount of residual urine are far more valuable than the apparent size of the prostate as ascertained by rectal and bimanual examination for it is a matter of common knowledge that the size of the prostate does not bear any constant relation to the disability and suffering. A cystoscopic examination helps very considerably in suitable cases for a vesical projection or a collar may be seen and the condition of the bladder ascertained. In some cases a pouch or a calculus may be seen in others carcinoma of the bladder is a surprise but it must not be forgotten that neither rectal nor vesical examination even through a suprapubic wound may discover any enlargement which appears to be sufficient to produce an obstruction that is known to exist. In such a case the prostate is unusually firm and only slightly enlarged as felt *per rectum* but the neck of the bladder or the prostatic urethra is nevertheless obstructed. In the last edition¹ of this work details were given of a case of this kind cured by prostatectomy. Legueu² discusses similar cases and thinks the obstruction is due to a rigid fibrous bladder neck the removal of which overcomes the obstruction.

Care must be taken not to mistake the hard fixed and nodular enlargement of the carcinomatous prostate for the adenomatous so called senile hypertrophy.

When the catheter can be used under the most favourable circumstances complications may be long delayed but sooner or later acute retention will supervene in the large majority of cases and this may be accompanied by intra vesical hæmorrhage and followed by cystitis either from infection arising from the careless use of instruments or from the rectum. Vesical calculi may slowly develop and the kidneys may become affected.

Complete retention incapable of relief by any catheters even when used by an experienced surgeon may develop at any time.

It is rarely wise to remove the prostate when an operation becomes necessary for complete retention. It is far better to be content with catheter or suprapubic drainage until the acute symptoms have subsided for the congestion of the prostatic plexus is extreme and the urine too often foul under these circumstances. Ascending nephritis and suppression of urine are especially likely to develop at this period. After a variable interval the prostate may be removed under more favourable circumstances if the patient prefers this to either permanent drainage or the almost certain return of his acute retention at no distant date. In a similar way preliminary drainage may be adopted in very feeble old men with much cystitis or chronic uremia and occasionally when large or encysted stones have been removed with delay and difficulty or severe hæmorrhage.

Unfortunately some patients do not seek treatment or do not consent to any operation until some complication or other has made life a burden and they may not consent to an operation until grave changes have taken place in the kidneys. It then becomes a difficult question to decide for or against a radical operation. Similar difficulties arise in

¹ Sixth Edition, ii 689

² *Med. Press and Circular* 1903 clxvii 506

advising patients who are very decrepit or suffering from cardiac, pulmonary or other diseases. Under these circumstances the danger of the operation is considerably increased, and the advantages derived from it may be comparatively short-lived, on account of the general condition of the patient and the shortness of the natural expectation of life.

In the absence of evidence of grave interference with the renal function, however, suprapubic prostatectomy may be undertaken by a skilful surgeon, with a sufficient experience of this operation, if the general health is good enough to justify the administration of an anæsthetic. Spinal anæsthesia induced with care is satisfactory in these cases, especially because it relaxes the abdominal muscles completely and thus makes the operation easier. Sacral regional anæsthesia¹ after scopolamin and morphia is also useful in very bad cases when other methods are contra-indicated.

In many cases the question of operation will depend upon (a) the possibility, or otherwise, of leading a catheter-life under circumstances which are favourable for avoiding septic infection; (b) the degree of discomfort and disability involved by catheter-life in the given case; (c) the risk of the operation for the patient under consideration; is it likely to be so great, on account of renal changes, general disease or extreme age, as to make the operation inadvisable, although it would, if successful, give great relief as long as life lasts?

In conclusion, it may be briefly stated that the cases in which, in my opinion, the operation is most called for fall into two groups. A. *The more urgent.* (1) Where previous appropriate treatment, carefully carried out, has failed. (2) Where there have been one or more attacks of retention. (3) Where hæmorrhage has taken place. In either case the peril of cystitis, too often fatal here, is enormously increased. (4) Where there is inability to micturate, but the patient is dependent upon the use of a catheter, and especially when he cannot pass this himself or get some one to do it for him with all the care and cleanliness that is necessary to prevent infection. This will depend largely upon the education and the means at the disposal of the patient; in a hospital patient it is far safer to operate than to allow the patient to attempt to pass a catheter himself. (5) Where micturition becomes increasingly painful and frequent. (6) Where the passage of the catheter is increasingly difficult, with the risks of hæmorrhage, formation of false passages, &c. (7) Where the prostate is soft and elastic, not hard and fibrous, the immediate risk of operating for the latter is greater, and the chance of a perfect result is less. The greater the power of voluntary micturition which remains, the more natural the urine as to urea, specific gravity, albumen and sugar, the greater the rallying power of the patient, and the clearer the mind the better the prognosis. B. *Less urgent cases.* Here the operation is prospective and preventive. The patient is younger, the power of voluntary micturition is still good, there is no cystitis, but palliative treatment fails to relieve the frequent disturbances at night and hæmaturia has begun to occur at intervals. Here the surgeon is abundantly justified in advising the operation as a preventive of worse things.

¹ B. L. Laver and B. G. Scholefield, *Guy's Hosp. Gazette*, 1925, xxiv, 303.

THE CHOICE OF OPERATION

The choice lies chiefly between suprapubic and perineal total enucleation. Partial suprapubic prostatectomy and all other partial removals are unsatisfactory either immediately or remotely or both.

(1) *Duration of the Operation* The suprapubic operation can be more quickly performed than any other except in the rare cases of small and adherent prostates.

(2) *Ease* The suprapubic is easier than the perineal operation in the great majority of cases and this is especially true for very large prostates. Sir J. Thomson Walker¹ successfully removed suprapubically a prostate weighing 1½ lbs.

(3) *Completeness of the Removal and certainty of Complete Relief* The suprapubic route allows the removal of the gland *en masse* and surrounded by its true capsule. This is a distinct advantage for the surgeon can be more certain of completely removing the prostate whereas in the perineal operation the enucleation is usually more or less piecemeal. Vesical projections are apt to be overlooked and hence the relief is less often complete after the perineal than after the suprapubic operation and under these circumstances stricture may develop. Such a serious sequel is very rare after a well performed operation with adequate care in the after treatment.

(4) *Exploration of the Bladder* No one denies that a suprapubic cystotomy allows the most complete examination of the interior of the bladder and the best guarantee that calculi, sacculi or growth may not be overlooked.

(5) *Incontinence of Urine* This not uncommonly follows the perineal operation from interference with the compressor urethræ or its nerves or both. Dr. Watson states that incontinence follows 3.5 per cent. of the perineal operations. On the other hand this troublesome sequel rarely or never follows the suprapubic operation for the operator working within the fibrous sheath of pelvic fascia does not damage the compressor urethræ or its nerves.

(6) *Rectal Injury* The rectum has been occasionally injured during the perineal operation and a troublesome recto urethral fistula has not uncommonly resulted. Dr. Watson states that it has occurred in 2.7 per cent. of the cases. There is practically no danger of this accident with the suprapubic method for the finger of the surgeon is kept well away from the rectum by the posterior wall of the strong fibrous sheath of the prostate. With dense and adherent prostates it is however possible to tear through this sheath and injure the rectum but this must be a very rare accident whereas Belfield states that perineal or rectal fistula occurred in 8 per cent. of 2,000 perineal prostatectomies.²

(7) *Drainage* This is a little freer with the perineal operation if the removal is complete and certainly as regards the wound it is better. It is a disadvantage however to have to pass a tube on to the bladder base where it induces more pain than the suprapubic tube properly inserted. Moreover the patient cannot sit up so comfortably and the sitting up posture is of value in avoiding pulmonary complications.

¹ *Brit. Jour. Surg.* 1900 vii, 56

² *Ann. of Surg.* 1907 xlv, 101

(8) *The Duration of Anæsthesia.* A shorter anæsthesia is required for the suprapubic operation, and therefore complications arising from the anæsthetic are less likely to follow it.

The lithotomy position is not a good one for a prolonged anæsthetic, especially in elderly men with rigid chests. It is, however, possible to perform both the perineal and the suprapubic operations under spinal or regional anæsthesia.¹

(9) *Urinary Fistula.* This is more common after the perineal operation. Judd² found six in 323 cases at the Mayo Clinic.

(10) *The Loss of Sexual Power and Sterility.* This is more common after the suprapubic operation than after a perineal one performed by Young's method. It should be remembered, however, that impotence is not uncommon before the operation and that the loss of sexual power is immaterial in the majority of cases, although it may be a serious matter in the few comparatively young men. Further, the sexual power is preserved in some cases after the suprapubic operation.

(11) Epididymitis is more common after the perineal operation.

(12) *The Comparative Mortality.* The mortality of the perineal operation is distinctly lower but more difficult and complicated cases are tackled by the suprapubic method. Thomson-Walker³ had a mortality of 8.42 per cent. in 820 suprapubic prostatectomies. H. H. Young⁴ had a mortality of 3.4 per cent. in 1,049 perineal prostatectomies.

(13) Pelvic cellulitis is a little more common after the suprapubic operation, because of the better drainage of the cellular tissues provided by the dependent perineal incision.

(14) The suprapubic operation is not suitable for the comparatively rare cases of contracted bladder with non-distensible walls.

In conclusion it may be stated that the suprapubic operation is the most suitable for critical cases, demanding a short operation with little shock and little anæsthetic; it is also to be recommended when the prostate is greatly enlarged, and when there are intravesical projections. When large stones or sacculi are present or a need for thorough examination of the interior of the bladder exists, the suprapubic route is the best. The perineal operation is more suitable for the removal of small hard enlargements, and in comparatively young men, to whom the sexual power is known to be of importance; it is also better when carcinoma is suspected. It is not easy to perform in fat and bulky patients.

The one operation should be the complement of the other, and neither of them should be exclusively adopted for all sorts and conditions of a variable disease.

SUPRAPUBIC PROSTATECTOMY. TOTAL ENUCLEATION OF THE PROSTATE

Although the late Mr. McGill,⁵ of Leeds, certainly removed large portions of the prostate bit by bit, and although the removal may have

¹ Young, *Journ. Amer. Med. Assoc.*, February 4, 1905; and *Practice of Urology*, 1926, ii, 434.

² *Journ. Amer. Med. Assoc.*, 1911, lvii, 458.

³ *Modern Operative Surgery*, ii, 698.

⁴ *Practice of Urology*, 1926, i, 490.

⁵ *Brit. Med. Journ.*, October 19, 1889. Dr. Fuller also removed most of the prostate suprapubically (*Journ. Art. and Gen. Urin. Dis.*, June, 1895, p. 232).

been complete in one or two cases there is little doubt that the credit of introducing and perfecting the operation of total enucleation of the prostate *en masse* belonged to the late Sir P. Freyer who first showed that this was a feasible and rational surgical procedure ¹

Partial prostatectomy however extensive was a very different thing from complete prostatectomy as now performed and it was not attended with sufficient success to justify its general adoption. It was in fact almost completely abandoned for other measures such as castration and vasectomy which held their sway for a time but were generally discarded because the results were poor and uncertain.

For much of the following description of the operation I am indebted to Freyer's instructive work upon the subject ²

Preparation If possible the patient should be kept at rest for two or three days before the operation the bowels should be opened daily and an enema given the evening before the operation. Any bronchitis that may be present should be attended to or in some cases which do not call urgently for relief the operation should be delayed until the pulmonary symptoms have abated.

In cases of chronic or subacute cystitis the bladder should if practicable be washed out once every day with a solution of oxymercure of mercury π ℥ followed by boracic lotion toward the end of the irrigation. If cystitis be absent lavage is neither necessary nor wise.

For cystitis certain drugs may be given with the object of lessening the alkalinity of the urine and of making the interior of the bladder less septic. Urotropine gr xvi may be given twice a day and acid sodium phosphate gr x to xxx with tincture of hyoscyamus m xxx may be added with advantage. gr x each of urotropine and boric acid are also useful.

Preliminary Cystostomy Preliminary drainage of the bladder is necessary in bad cases of cystitis with deficient renal function. In many of these cases tying in a catheter suffices but in the worst suprapubic cystostomy is invaluable in that it provides freer drainage overcomes cystitis restores the renal function and thus reduces the mortality of the operation. When the blood urea becomes normal the prostate can be removed with comparative safety.

Operation The choice of anæsthetic is as important as the skill and care in its administration. Thomson Walker ³ prefers spinal anæsthesia with a modified dose of stovaine and just sufficient C. L. to render the patient unconscious. The fall of blood pressure which may amount to 20 or 40 mm. of mercury can be compensated by adopting the Trendelenburg position and by keeping the head low after the operation. On account of this fall of blood pressure this anæsthetic is not suitable for patients suffering from arterio-sclerosis and myocardic changes. Gas and oxygen makes the abdominal muscles rigid so that without a large incision to allow the whole hand to get deep to the muscles it is difficult to enucleate the prostate. I have found warm ether and oxygen following morphia and atropine very satisfactory and in bad cases sacral anæsthesia with infiltration of the abdominal wall is excellent ⁴

¹ *Brit Med Journ* July 20 1901

² *Enlargement of the Prostate* 3rd ed. 1906

³ *Brit Med Journ* 1913 i 137

⁴ Lowsley (*Brit Med and Surg Journ* September 27 1913 p 441) described the technique of sacral anæsthesia. See also *Guj's Hosp Gazette* 1915 xxxix 303

The bladder is thoroughly washed out through a large-sized catheter and then distended with boracic lotion. If he prefers to use his left forefinger for the enucleation the surgeon stands on the right side of the patient; he has no glove on the left hand, but two on the right. A vertical median incision, three and a half inches long, is made with its lower extremity at the pubis. The rectus sheath is opened, the muscular fibres separated and any hæmorrhage arrested.

With the left index finger inserted at the lower end of the wound the



FIG. 351. Suprapubic enucleation of the prostate. The figure shows how the prostate is supported by two fingers and the thumb of the right hand, while the left forefinger enucleates the gland.

prevesical fat is displaced upwards, carrying with it the peritoneum out of harm's way and leaving the bladder exposed.

A bloodless spot is selected and the knife plunged into the bladder; as it is withdrawn the incision is enlarged downwards, so that it is about an inch long. The wound is enlarged by stretching with two fingers if this becomes necessary later on. This has the advantage of avoiding any increase of hæmorrhage. The left forefinger is introduced as the knife is withdrawn, and the plug is taken out of the catheter so that the contents of the bladder can run away into a sterilised dish, in order to avoid a mess. The vesical orifice and the whole of the interior of the bladder are carefully and rapidly examined so that no calculus or stone-bearing diverticulum may be overlooked. Any calculi present are at once removed with forceps or scoop, and the right forefinger is introduced into the rectum to push

the prostate forwards and steady it I often use two fingers to get a better grip

Now the surgeon uses the left forefinger to scratch through the mucous membrane over the prominence of the median or lateral vesical projection, so that he may not go too deeply and thus miss the proper layer for enucleation, for the prostate is covered only by thin mucosa on its vesical surface. It is very important to take time to find the proper layer for the separation and not to trespass upon the fibrous sheath with its venous plexus. If the first incision is carried too deeply true enucleation becomes impossible and the difficulties and dangers of the operation are greatly increased, hæmorrhage is more profuse much valuable time is wasted and

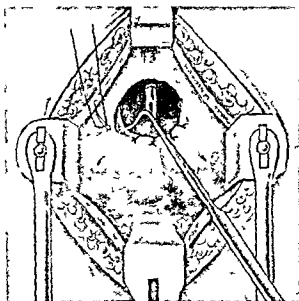


FIG 352 Suprapubic prostatectomy. The bladder base and prostatic space are displayed; a flap has been removed from behind the vesical orifice and hæmostatic sutures inserted. (After Thomson Walker.)

the removal is apt to be incomplete. Moreover stricture is far more likely to develop.

During the enucleation the prostate is fixed between the rectal and vesical fingers, the triangular ligament and the pubis. An assistant's finger in the rectum is not so valuable, for the operator cannot direct it so well nor can he get the same control over the prostate. The combined action and sense of touch of the operator's own fingers are far more useful, when the prostate is very large two fingers are useful within the bladder. The separation is carried on firstly behind and at the sides, and finally in front of the prostate the finger being always kept close to the prostate and between the pathological capsule and the fibrous and vascular sheath of pelvic fascia until the gland is free, except below where the urethra attaches it to the triangular ligament. If there is any difficulty in reaching the lower part of the posterior surface of the prostate the middle finger may be used, with the index finger, for the enucleation,

and the whole hand is inserted in the prevesical space. The tip of the finger is now bent and gently separates the urethra from within the apex of the prostate all round as far as possible, the catheter serving as a useful guide. Then the finger behind the prostate and urethra hooks the prostate upwards and forwards, with the result that the urethra snaps above the insertion of the ejaculatory ducts; above this point the mucosa is more closely attached to the prostate and comes away with it. Freyer stated that the insertions of the ejaculatory ducts are often preserved and remain attached to the lower part of the prostatic urethra, which is firmly fixed

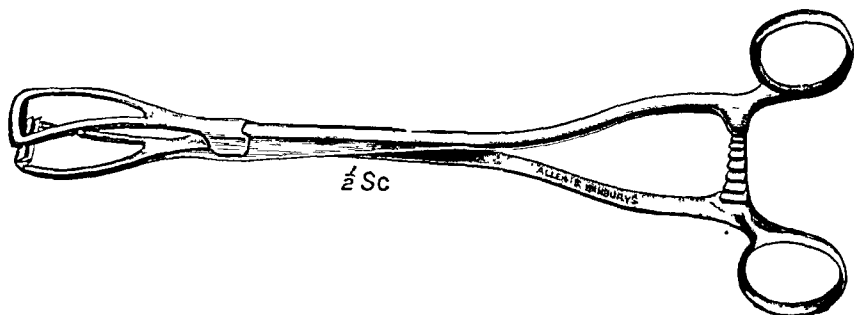


FIG. 353. Young's prostatic forceps.

to the triangular ligament. At the end of the manœuvre, which has been just described, and aided by a finger in the rectum, the prostate is shot up into the bladder.

Before the finger is removed from the rectum the walls of the cavity which contained the prostate are bimanually compressed or massaged so as to diminish hæmorrhage and the size of the space that is left to heal. Any ledge of mucosa separating the bladder from the prostatic space is divided posteriorly in the middle line with the fingers or, if necessary, with scissors. This tends to join the two cavities, to abolish any mem-

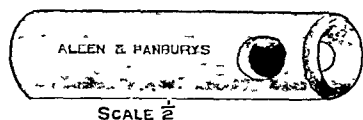


FIG. 354. Suprapubic drainage tube (Freyer's).

branous flap and to prevent a stricture at this spot. When the finger is withdrawn from the rectum the nurse holds the upper end of the right outer glove and slips it off, and the surgeon rinses his hand covered with the second glove in strong *lotion*. The prostate is withdrawn by suitable

forceps held in the right hand and guided by the left forefinger in the bladder.

The forceps compress the gland sufficiently to allow the removal through a comparatively small vesical incision.

Sir J. Thomson-Walker¹ excises a wedge-shaped piece of mucous membrane here and sews the posterior edge of the prostatovesical opening with fine catgut (Fig. 352). In order to do this he makes a long incision, introduces his bladder retractors, and uses a head-lamp, the patient being in the high Trendelenburg position. In this way he aims at preventing stricture, hæmorrhage and sepsis from retained debris and blood clot. He also has ceased to introduce a finger into the rectum, finding this unnecessary when using a large suprapubic wound admitting

¹ *Brit. Journ. Surg.*, 1920, vii, 525, and *Brit. Med. Journ.*, 1923, i, 133.

which pass deeply and approximate the muscles and fasciæ so that a ventral hernia may be prevented. No buried sutures are used. A piece of thin rubber tubing is tied to the projecting outer end of the tube to conduct the urine away and keep the patient dry during the first three days. The wound is covered with a pad of sterilised gauze, a thin layer of cotton wool and much cellulose wadding, which ensheaths the back and sides as well as the front of the pelvis. A many-tailed bandage is used to keep the dressings in position. The testicles are supported by a suitable cushion.

Clifford Morson¹ advocates the routine division of the vasa deferentia, between catgut ligatures just below the external ring, as a sure preventative of epididymitis as a complication of prostatectomy, a complication which Winsbury White found to be very common at St. Peter's Hospital. We are not convinced that this step is necessary, for we have not found epididymitis a common or troublesome complication.

The After-Treatment. This is almost as important as the operation, and much depends upon the care and thought with which it is carried out. Free drainage is essential for success, and any failure may induce pain and hæmorrhage from distension; cystitis, cellulitis or renal complications may develop.

Irrigation should be carried out once daily through the suprapubic drainage tube, the thin rubber tubing being detached for the purpose and a rubber catheter, attached to an irrigating can, being passed through the rubber tube and well into the bladder; the fluid returns freely through the drainage tube, the patient being turned on his side.

Very little hydrostatic pressure is either advisable or comfortable at first, the can or funnel being only about six inches above the level of the abdomen; distension is painful and apt to cause hæmorrhage.

Warm boracic lotion is the best for general use, but when cystitis develops, or rather pre-exists, a solution of oxycyanide of mercury (1 in 4,000) should be used, followed by the boracic lotion.

The patient should be kept still for the first twenty-four hours, but as soon as the shock is over he must be propped well up and made to lie alternately upon his sides and back, so that pulmonary complications may be avoided. The outer dressings should be changed whenever they get wet so that the skin may not get sore or the patient uncomfortable; the skin is protected with an ointment containing zinc oxide, lanoline and castor oil. Shock should be treated as already described (p. 9), and hæmorrhage by subcutaneous injection of pituitrin, free drainage of the bladder and raising the foot of the bed; packing the prostatic space with a long strip of iodoform gauze or pressure by means of Pilcher's rubber bag, drawn into position by a catheter introduced through the urethra, may be needed in severe cases. Axillary infusion, a pint in each axilla, is valuable, and in grave cases intravenous infusion of one pint of gum solution, followed by blood transfusion, is indicated. Pain should be relieved by aspirin by day and, if necessary, by a small dose of morphia or heroin by night, unless the kidneys are gravely affected. Threatening uræmia should be met by drinking an abundance of fluid and by infusion of saline solution if fluid is not retained by mouth or rectum. Diuretics, purgatives and diaphoretics should be tried and, above all, albuminous food should be avoided. The bowels are kept open daily after the second day.

¹ *Brit. Med. Journ.*, 1923, ii, 1032.

The drainage tube can be safely removed on the third day, there being no fear of extravasation into the pelvic cellular tissues. Irrigation is then carried out by introducing the catheter through the sinus as long as this is practicable and then by hydrostatic pressure through a catheter inserted into the meatus, but this is rarely required and in any case, will not become necessary until about the ninth day. It is rarely necessary to pass or tie in the catheter either to prevent or overcome a stricture. Its introduction and its continued presence only serve to irritate the urethra and the healing part without any compensating advantage. The urine should begin to come away through the urethra after about ten to fifteen days and should be voided entirely along the natural passage after about three weeks or a month. Certain drainage apparatus such as those of Irving or White may be found useful to keep the patient dry but the wound

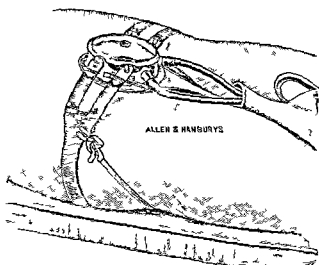


FIG 356 Suprapubic apparatus (Hamilton Irving's) with metal cup india rubber belt, tubing and understraps

heals better without any of these and the patient is freer to get up and move about. He is allowed to get up a little on the fourth day. This enables the bowels to be opened with greater comfort and efficiency, and it also tends to prevent pulmonary complications and maintains the muscular tone. Hamilton Irving's apparatus is a good one, the cup must be made of metal and boiled every day to keep it perfectly clean.

OPERATION IN TWO STAGES

In certain cases it is wiser and safer to perform the operation in two stages. It is very rarely right to perform prostatectomy in the presence of complete retention, it is safer to deal with the retention first, either by catheter, suprapubic puncture or suprapubic cystostomy. In this way the risk of hæmorrhage, suppression of urine, ascending nephritis and other complications are diminished, for the kidneys are considerably damaged, congested and often inflamed as a direct result of the retention. Then the shock of a severe operation is too great for the maimed kidneys.

which may cease working. Similarly, when there is much cystitis, with chronic urinary retention, especially if the urine is scanty or there are signs of chronic uræmia in a feeble patient, perhaps with other visceral disease such as chronic bronchitis, it is wise first to drain the bladder freely by suprapubic cystostomy and to defer the prostatectomy until the kidneys and the general health are in a better condition. When a catheter cannot be passed owing to the enlarged prostate or stricture of the urethra with false passages or when an indwelling catheter is either intolerable or ineffectual for the treatment of retention of urine, suprapubic cystostomy is strongly indicated. It is often remarkable to notice the rapid improvement following the preliminary drainage.

Stones are found in the bladder in 20 per cent. of the cases of enlarged prostate coming to operation. As a rule, these are easily removed and scarcely add to the duration or danger of the operation, but when there is much delay, difficulty or hæmorrhage associated with the removal of stones from the bladder or from a sacculus, it is wise to defer the prostatectomy to a later date. When stones had to be removed at the time of prostatectomy Freyer found the mortality in 190 cases to be nearly double that of simple prostatectomy, but stones form chiefly in the late and bad cases with cystitis, so that the increase of mortality is only partly due to the addition of lithotomy to prostatectomy. It is, I think, chiefly due to the more serious deterioration of the kidneys and general health.

Although there are advantages in performing the operation in two stages in selected cases, it should be realised that secondary prostatectomy is often more difficult, and it carries with it the dangers associated with an additional anæsthetic and an additional period of confinement, which is irksome and somewhat dangerous to an old man. The preliminary cystostomy can be performed under local anæsthesia in bad cases with great advantage to the patient. To gain the full benefits of the two-stage method it is wise to wait for at least ten days before enucleating the prostate; by that time the blood urea has dropped to the normal in most cases and cystitis has disappeared. Sometimes, however, it is necessary to wait for weeks or months before the renal condition is favourable for the final operation.

Freyer relates the following as a typical example of one of the conditions under which it is advisable to divide the operation into two stages, so that the uræmic symptoms may pass off and the kidneys regain their full excreting powers before removing the prostate. Had the gland been removed without preliminary drainage in this case, the shock to the damaged kidneys would probably have induced total suppression of the urine.

"A patient, aged 66, consulted me on April 29, 1912, on the advice of Dr. T. M. Tibbetts, of Old Hill, Staffs. suffering from prostatic symptoms which had existed for twelve years, gradually increasing in intensity. For months previously he had had the catheter passed three times daily at a hydropathic institution, but latterly he did not employ the catheter. The bladder was greatly over-distended, the patient having to pass urine hourly by day and by night. During the previous three months he had suffered from extreme thirst, headache, bitter taste in the mouth, with gradual loss of energy and appetite—symptoms which indicated uræmic poisoning. I drew off 32 oz. of residual urine, colourless like water: specific gravity 1005, and containing a trace of albumin. The prostate felt much enlarged, dilated, dense, and movable. Owing to the uræmic symptoms I decided to drain the bladder

suprapubically before removing the prostate so as to relieve the backward pressure on the kidneys and thus enable them to regain their functions

Assisted by Dr Tibbitts I performed suprapubic cystostomy on April 30 and found that the prostate presented a tongue shaped outgrowth in the bladder. The previous uræmic symptoms continued for some days and troublesome hicough supervened but all these symptoms gradually subsided so that on May 14 assisted by Dr Tibbitts I was able to complete the operation. The prostate which was pear-shaped and weighed 3 oz was easily enucleated. The suprapubic wound was completely closed on May 31 and on June 15 the patient went home in excellent health able to retain and pass his urine as well as he ever did. On March 6 1913 I wrote to me "I never felt better in my life. I have never since had any pain or inconvenience. my urinary flow is perfect and my appetite splendid."

RESULTS OF SUPRAPUBIC PROSTATECTOMY

In 1911 P. J. Freyer who had great experience of this operation reviewed the results of his first 800 cases and in 1913 he reported 236 additional operations performed during 1911 and 1912. I venture to quote from his last paper

There were in connection with these 236 operations 11 deaths or 4.66 per cent

Reviewing briefly my experience of this operation to the end of 1912 comprising 1036 cases the patients varied in age from 49 to 90 years with an average age of 69½ years. There were amongst them 65 octogenarians and 11 bordering on this age viz 79 years. The prostates removed ranged from ½ to 17 oz in weight the approximate average being 2½ oz. Though the patients were of course mainly drawn from the British Isles practically every nation and race on the face of the earth are here represented. The great majority had been dependent on the catheter for periods ranging from a few days to 24 years. Most of them were in bad health and many were apparently moribund when the operation was undertaken. Few of them were free from one or more grave complications kidney affections resulting from backward pressure on those organs predominating. In the larger number existence was rendered so painful and miserable that they were prepared to face any risk from operation provided they could be assured that in case of survival they could dispense with the catheter.

In connection with these 1036 operations there were 57 deaths or 5½ per cent the remaining 979 cases with the exception of one case being completely successful. In only this one case has the patient failed to regain the power of voluntary micturition and in this instance the bladder was quite flaccid and seems to have been completely paralysed by the extreme over distension by the urine before the catheter was employed. With experience the mortality has gradually diminished from about 10 per cent in the first 100 cases to a little over 4½ per cent in the last 400.

The causes of death were uræmia due to chronic kidney disease 24, heart disease 9, shock 7, exhaustion 3, septicæmia 3, mania (hereditary in one case) 2, malignant disease of the liver 2, bronchitis, 2, pneumonia 1, heart stroke 1, pulmonary embolism, 1, cerebral hæmorrhage with paralysis 1, and acute pancreatitis 1. Though all these deaths are accepted in connection with the operation in not more than half the number can the fatal result be attributed thereto, the

remaining deaths being due to disease incident to old age and unconnected with the operation. Had the cases been selected the mortality would have been infinitesimal, but, as will have been gathered from the successful cases given in detail in my numerous papers which have appeared in the *Lancet* and *British Medical Journal* during the last 11 years, selection would have condemned a large proportion of them to a painful death after prolonged suffering instead of the complete restoration to health that ensued after the operation.

"In 190 cases the prostatic disease was complicated by the presence of stone in the bladder, mostly of the phosphatic variety due to cystitis. The operation in these cases partook, of course, of a dual character—prostatectomy in addition to suprapubic lithotomy. Amongst these there were 16 deaths (all of which have been accepted as resulting from the prostatectomy part of the operation), or 8.42 per cent. Amongst the remaining 846 cases uncomplicated with stone, there were 41 deaths, or 4.84 per cent., so that the mortality amongst the former was nearly double that amongst the latter.

"One of the most satisfactory features of this operation is that the patients as a rule state, after the lapse of months or even years, that they feel from 10 to 20 years younger than before the operation. This remarkable rejuvenescence has so much impressed me that, apart from the physical pain and mental depression caused by the obstructive symptoms, I am persuaded that the enlarged gland pours into the system some internal secretion of a toxic or deleterious nature."

The late Sir Peter Freyer's experience of the operation was unrivalled. his dexterity great and his results so very good that the young surgeon is in danger of being led to believe the operation simple, easy and almost devoid of danger, leading almost inevitably to a complete recovery and a perfect functional result.

It is my duty to warn him and to say that he will occasionally find the operation very difficult, and that he must be very careful to find the proper layer for separation, aiming not for marvellous speed but for perfect work. Speed will come with time and experience. The mortality in the hands of the *average* surgeon is not likely to be much below 8 per cent., although in the hands of experts it may be as low as 5 per cent. Between 1901 and 1918, 1,276 suprapubic prostatectomies were performed at St. Peter's Hospital with a mortality of 8.13 per cent.¹ The after results are not always perfect, often there is a little frequency and uncertainty of micturition.

Sometimes cystitis and occasionally a stone forms in the bladder. Very rarely a stricture develops. It has been said that such a thing is unknown but I know of several instances, all following difficult removals of small prostates.

Sometimes the prostatic space is not quickly obliterated, but granulates and bleeds, and phosphatic deposits may form there. Such a case was referred to the writer, after the operating surgeon had diagnosed malignant disease. The sound struck a stone, the size of a walnut and very irregular on the surface, occupying the prostatic space, whence it was dislodged suprapubically with considerable difficulty. The man, who was in great misery, made a complete recovery. Very rarely the

¹ Sir J. Thomson-Walker, *Brit. Journ. Surg.* 1920, vii, 525.

power of the bladder or even its capacity may not be completely restored, especially when the operation has been too long deferred

But when all is said the results are unexpectedly and remarkably good, especially when pains are taken to acquire the peculiar skill required, and when patience is bestowed upon the after treatment

PERINEAL PROSTATECTOMY

Operation This operation was strongly advocated and well described by Proust¹ Albarran and others on the Continent warmly supported it In America H H Young of Baltimore and others vastly improved and popularised the operation It has never been very popular in England owing to the earlier knowledge of the brilliant results of the suprapubic

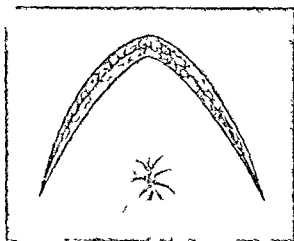


FIG 357 Perineal prostatectomy H H Young's incision crossing the perineum $1\frac{1}{2}$ inches in front of anus and ending midway between the anus and the tuber ischi (After H H Young)

operation Of late American and Continental surgeons have been more frequently adopting the suprapubic route Morphia and scopolamine injected subcutaneously and followed by sacral analgesia, with novocain, 3 per cent provides the best and safest anæsthesia Gas and oxygen is safe in most cases but spinal anæsthesia lowers the blood pressure too much

The bladder and urethra having been washed out and the patient placed in the extreme lithotomy position with a sandbag behind the sacrum, so that the perineum almost faces upwards,² the perineum and external genitals are thoroughly cleansed and isolated by aseptic towels A sound is passed into the prostatic urethra and held by an assistant A curved incision is made crossing the middle line $1\frac{1}{2}$ inches in front of the anus and ending on either side half way between the anus and the tuberosity of the ischium The central tendinous point of meeting of the perineal muscles is sought, and a transverse incision made

¹ *Med Press* October 1901

² H H Young uses a special table in which the correct position is obtained automatically (*Practice of Urology* 1926 ii 414)

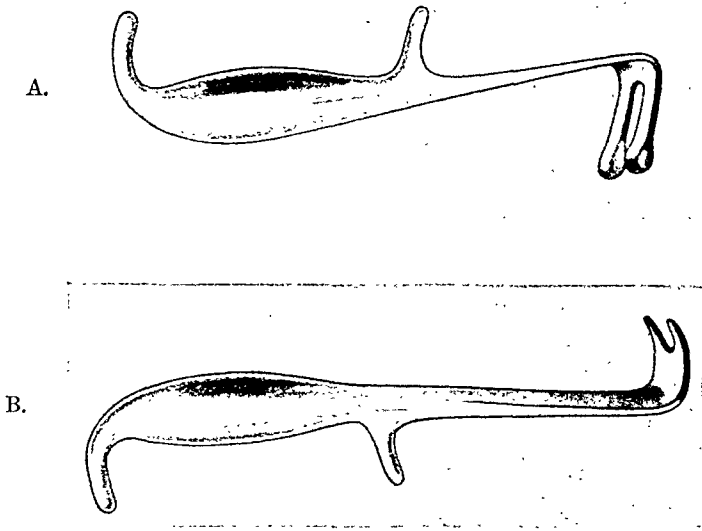


FIG. 358. Young's retractors for perineal prostatectomy. A has blunt ends to avoid injuring the rectum when the latter is drawn backwards. B is used to draw the bulb and perineal muscles forwards; its prongs are on either side of the urethra. (After H. H. Young.)

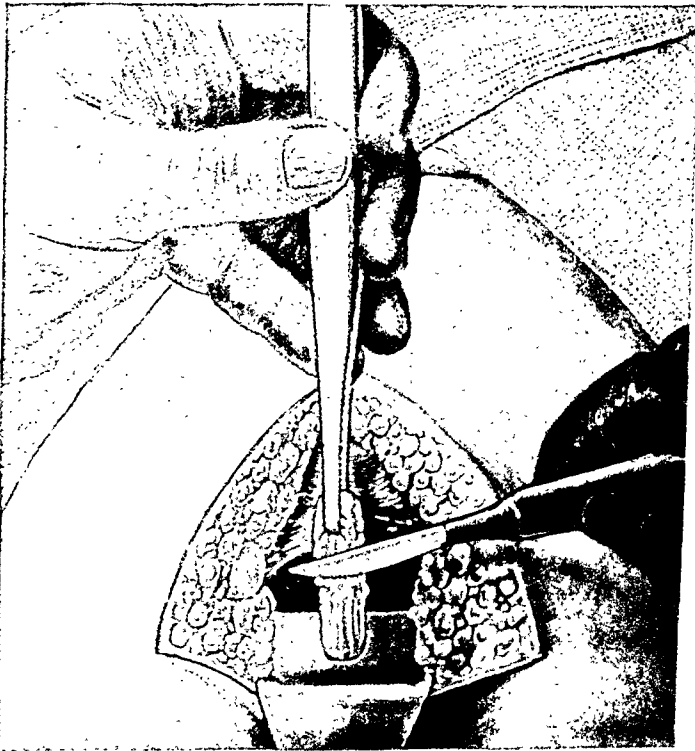


FIG. 359. Young's perineal prostatectomy. Division of the central tendon just behind the bulb; the bifid retractor helps. (After H. H. Young.)

through it separating the accelerator urinæ and transverse perineal muscles from the sphincter ani insertion. This step is of great importance

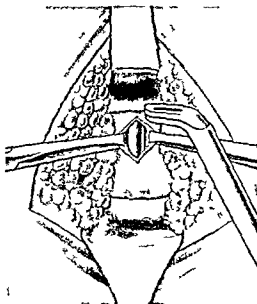


FIG 360 Young's perineal prostatectomy. Membranous urethra pencil at apex of prostate upon the sound. Prostat e tractor ready for insertion. (After H. H. Young.)

and must be carefully taken otherwise the rectum may be injured by working too far backwards or the triangular ligament by working too far forwards. The rectum and its fibrous sheath are now carefully displaced

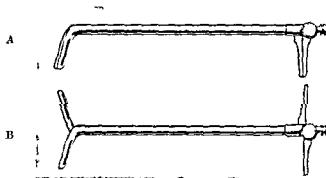


FIG 361 Young's prostat e tractor. A closed. B opened as when inserted and in use. (After H. H. Young.)

backwards by blunt dissection which is carried deep enough to expose freely the posterior surface of the fibrous sheath of the prostate. The wound is well opened with retractors, a wide flat bladed one to protect the rectum behind and a bifid one to encircle and display the urethra in front. The latter is opened exactly in the middle line upon the stuff well

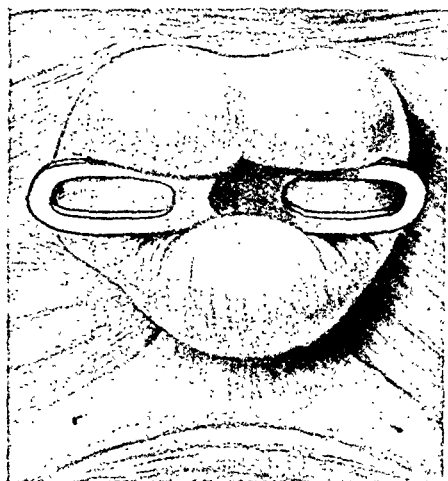


FIG. 362. Young's prostatic tractor opened in the bladder to pull the prostate downwards. (After H. H. Young.)

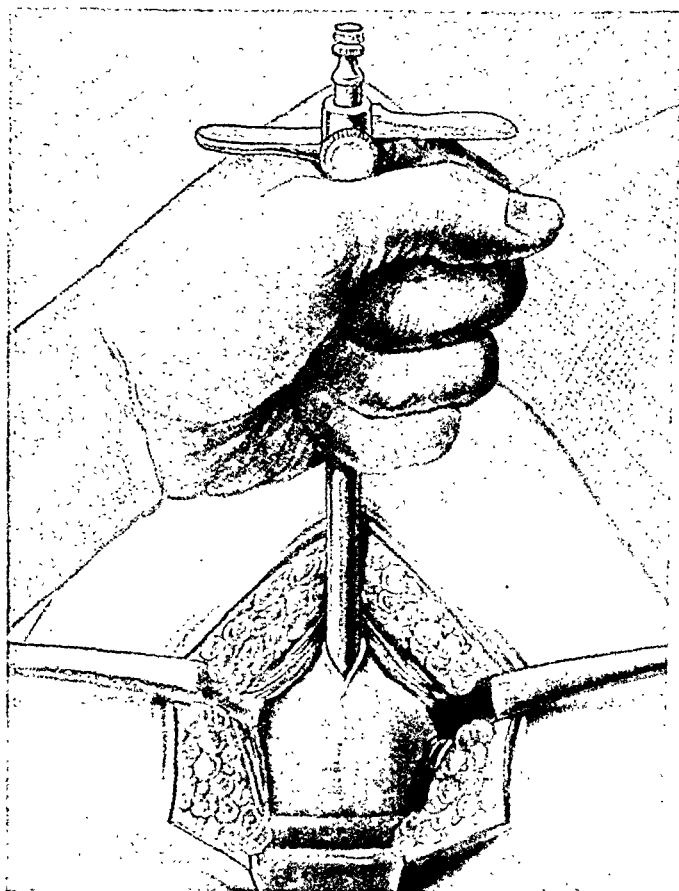


FIG. 363. Young's perineal prostatectomy. Tractor in use. The rectum and its fascial protection drawn back to expose the prostatic sheath. (After H. H. Young.)

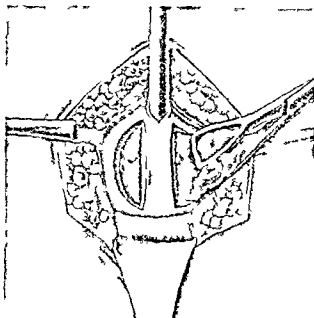


FIG. 364. Young's perineal prostatectomy. Enlargement of lateral lobes through two parallel capsular incisions. (After H. H. Young.)

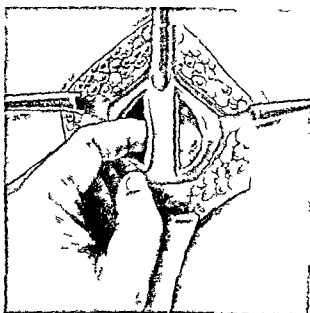


FIG. 365. Young's perineal prostatectomy. After removing both lateral lobes the median lobe is pushed with the index finger into the left lateral cavity and enucleated. (After H. H. Young.)

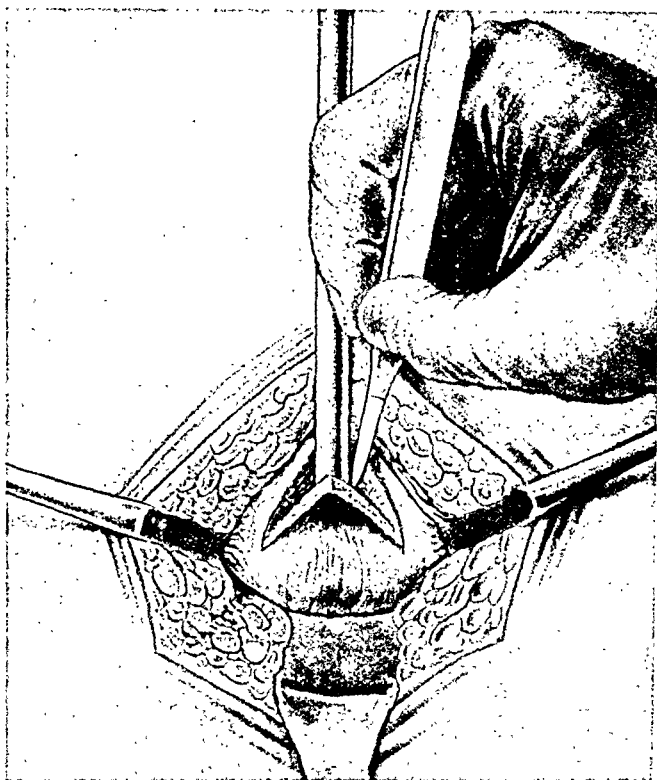
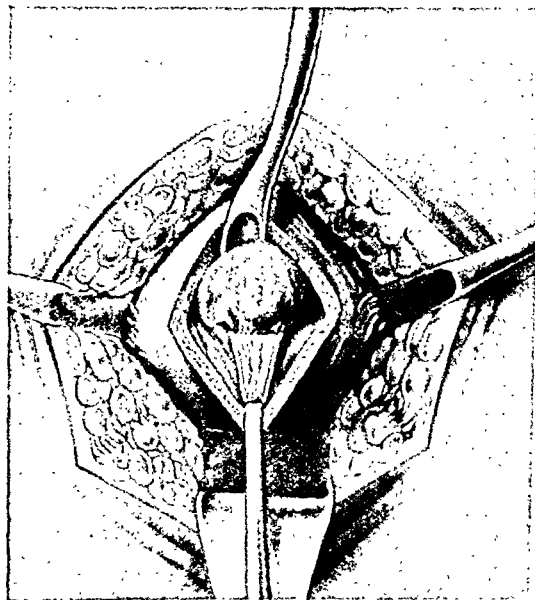


FIG. 366. Young's perineal prostatectomy. Inverted V capsular and urethral incision to expose lateral lobes, and to turn back the urethral floor. (After H. H. Young.)



Perineal prostatectomy. Enucleation of pedunculated middle lobe by means of a spoon tractor. (After H. H. Young.)

above the triangular ligament and through the apex of the prostate to avoid any possible injury of the sphincter urethra. The edges of the urethral incision are picked up and retracted with tissue forceps thus displaying the sound which is then withdrawn.

Young's tractor is then passed through this opening well into the bladder its blades are opened out. Traction is then made with the blades of the instrument directed laterally above the lateral lobes of the prostate (see Fig. 362). These and similar tractors are of great value in bringing the prostate downwards and backwards well into view. Care must be taken especially towards the end of the enucleation not to exercise too much force with tractors lest the blades tear through the thin vesical mucosa and bring away the urethra and vesical outlet.¹ When the shiny posterior surface of the prostatic sheath is displayed two lateral incisions are made through it, so as to expose the true capsule within (Fig. 361).

Young² used these lateral incisions 2 cm apart in order to avoid injuring the ejaculatory ducts which run between the two incisions.³ He still thinks they are the best as a rule being followed by more rapid closure of the wound and slightly greater preservation of sexual power. He sometimes uses a single oblique lateral incision but this gives less room sometimes an inverted V shaped incision thus turning back a flap including the verumontanum and floor of the urethra. This allows the whole prostate to be removed in one piece (Figs. 366 and 369). The lateral lobes are then separately enucleated with the aid of blunt dissectors and the index finger. When freely separated each lobe is withdrawn if necessary with the aid of forceps. The position of the tractor is then changed so that one of its blades engages and brings down the median lobe into one of the lateral incisions in the fibrous sheath. If this is not found to be practicable the finger may be used instead of the tractor. Dr Young often removes the median lobe together with the right lateral lobe. Sometimes a spoon tractor is necessary to bring down and enucleate a pedunculated intra vesical middle lobe (Fig. 368). If a stone is present in the bladder it may be removed by the scoop which is always passed to seek one. It may be necessary to dilate or divide the vesical neck and sphincter but this is not harmful if the urethral sphincter or compressor urethrae is not damaged. Young has thus removed a stone measuring 2½ inches in diameter. He frequently stitches up the divided sphincter. All bleeding points are carefully tied and the anterior wall of the rectum is examined and carefully protected by sewing the separated edges of the levatores ani over it with continuous catgut.

A Davis rubber bag is inserted to prevent hæmorrhage to bring down



Fig. 368. Young's spoon tractor for removing intra vesical middle lobe of the prostate. (After H. Young.)

¹ Watson *Ann of Surg* 1901 xxxix 853

² *Journ Amer Med Assoc* October 24 1903

³ Nicoll occasionally used similar incisions *Lancet* April 14 1894

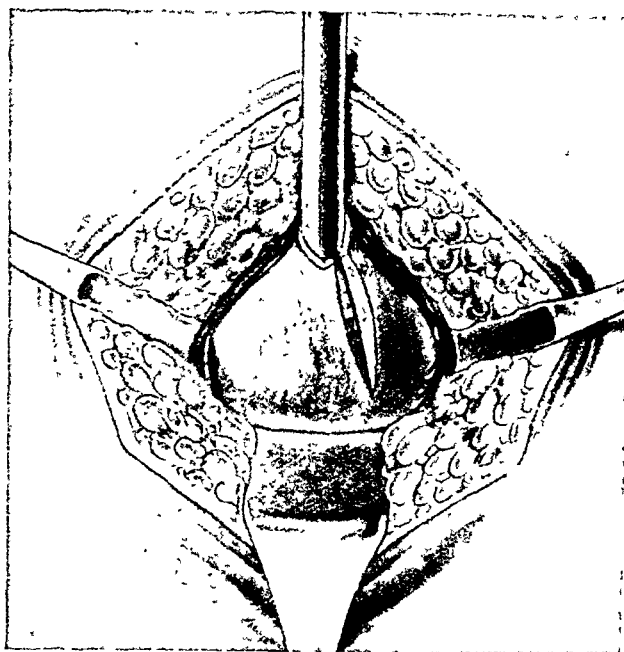


FIG. 369. Young's perineal prostatectomy. Single oblique incision avoiding the ejaculatory ducts. (After H. H. Young.)

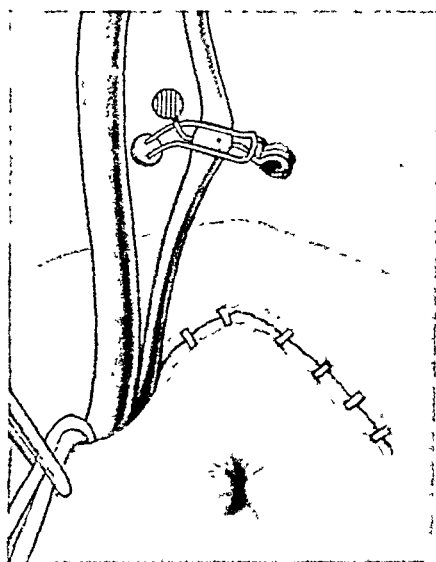


FIG. 370. Perineal prostatectomy. Davis perineal hemostatic bag and drain in place. Filling tube clamped, traction tapes held by forceps; a pad of gauze is inserted between the forceps and the perineum. (After H. H. Young.)

the vesical mucous membrane into the correct position and to drain the bladder. Young¹ speaks very highly of the Davis bag, which has added much to the safety and simplicity of the after-treatment and makes it unnecessary to use any gauze packing. The wound is closed around the

¹ *Practice of Urology*, 1926, ii, 446.

tubes and tape holding the bag in position. The bag is filled by injecting 50 or 60 c c of water into it, and it is drawn down into the proper position by means of the tape attached. The tube is closed by a clip and the tape is clamped over a pad outside the wound, to keep it in position. The large rubber tube drains the bladder and is used for irrigation.

If there is no bleeding after six hours, Young allows the bag to recede into the bladder, if no bleeding ensues within the next few hours some of the water is let out of the bag. If all goes well the bag is emptied and removed next day. The perineal wound is kept scrupulously clean and irrigated with a weak antiseptic solution when the dressings are changed and after defecation. vesical irrigations are rarely required.

Dr Young maintains that it is quite possible to remove all the prostate in segments without damaging the ejaculatory ducts and 80 per cent of his patients have preserved or regained their sexual power.¹ This, although immaterial in most cases, may be of great importance in some especially in comparatively young men of between 40 and 50. Epididymitis is said to be far less common when the ejaculatory ducts are not divided, when their open ends are left in the deep wound, septic inflammation may travel along them to the epididymis.

Causes of Death after Operations for Enlargement of the Prostate.

(1) Uremia is by far the commonest, (2) shock, (3) hæmorrhage, (4) cardiac failure, (5) ascending suppurative nephritis, (6) pelvic cellulitis, pulmonary complications, pneumonia or bronchitis, (7) mania and other forms of insanity, (8) pulmonary embolism.

PRIMARY MALIGNANT DISEASE OF THE PROSTATE

This is a comparatively rare cause of enlargement of the prostate, although it is not so uncommon as is generally believed and for this reason it is important to examine thoroughly all prostates which are removed for supposed adenomatous enlargement. Carcinoma is by far the commonest malignant growth and Holmes Green estimates that from 5 to 10 per cent of the senile prostatic enlargements are carcinomatous. Freyer² states that 13.4 per cent of his 1276 cases of enlargement were malignant, only one of these was sarcomatous. R. H. J. Swan,³ adding 28 of his own cases to those of H. Wade and Sir J. Thomson Walker, found that 34, or 12.9 per cent, of 262 prostates, supposed to be benign before removal, proved to be carcinomatous on microscopic section. Whenever there is any difficulty in enucleating the prostate, or any part of it is found to be unusually tough, firm, friable or locally adherent, carcinoma should be suspected. It is, however, probable that some pathologists have accepted insufficient evidence of malignant changes in the adenomatous prostate. Carcinoma occurs in men who are well advanced in years. The average age of 19 cases which were collected by Holmes Green was 68 years,⁴ and of 100 cases collected by Kaufmann all were over 40, and 68 per cent were between 50 and 70 years of age.⁵ Sarcoma is much less common and occurs in younger subjects.

¹ *Ann of Surg*, 1905, xli, 549, and *Practice of Urology*, 1926 ii 441.

² *Lancet*, December 13 1913.

³ *Lancet* 1923, ii, 971.

⁴ *New York Med Journ*, October 24, 1903.

⁵ Hawley, *Ann of Surg*, 1904 xxxix, 893.

The carcinomatous prostate differs from the adenomatous in being nearly always much harder, far more fixed and nodular upon the surface. It also gives rise to much more pain in the perineum, penis, sciatic region, and rectum. Bleeding is also more common and occurs more frequently apart from retention and instrumentation. Later on the iliac and groin glands may be enlarged, the rectal wall invaded and metastases may become evident, especially in the bones. These may appear when the primary growth is comparatively small and removable, so that it is important to examine for them.

Operations. (a) **Suprapubic Prostatectomy.** Enucleation by this route has been performed in many cases of early and generally unsuspected malignant disease. Fortunately many of these patients have lived for years without recurrence. In late cases the removal is incomplete and unsatisfactory, being followed by recurrence and death within a year or two, often after the return of obstruction demanding permanent suprapubic drainage. No surgeon would advocate this method for the removal of definite and hard carcinoma of the prostate: the attempt to remove an adherent prostatic carcinoma in this way is meddlesome surgery and is to be heartily condemned.

(b) **Perineal Prostatectomy.** Since Billroth's original case of perineal extirpation in 1859 many attempts have been made to perform radical

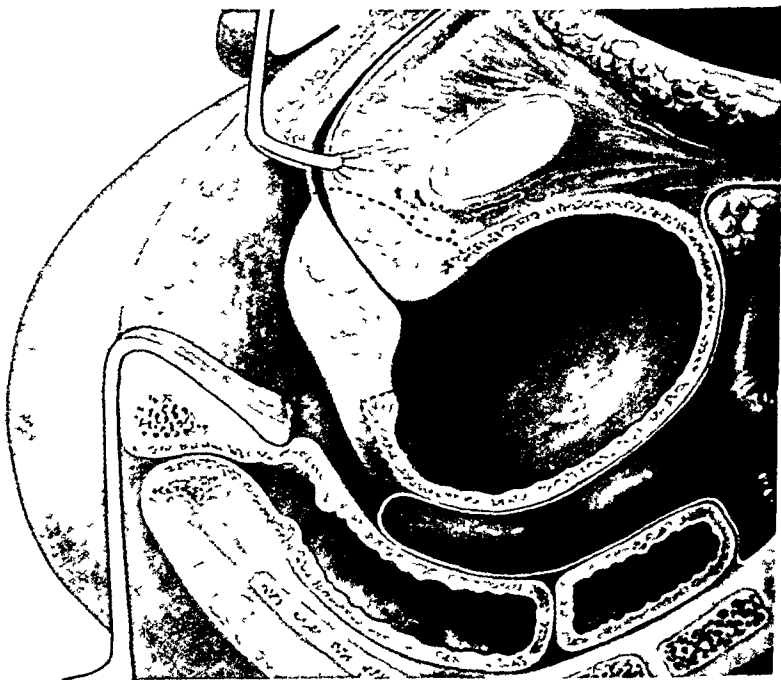


FIG. 371. Young's operation for excision of carcinomatous prostate. Sagittal section showing the exposure; the dotted lines indicate the parts removed. (After H. H. Young.)

operations for malignant disease of the prostate, but most of the attempts have been made far too late, so that many have considered operative inter-

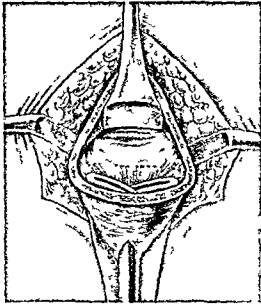


FIG 37' Excision of carcinomatous prostate The dotted line shows the site of incision 1 cm below the ureteral orifices The prostate has been drawn downwards and turned backwards (After H H Young)

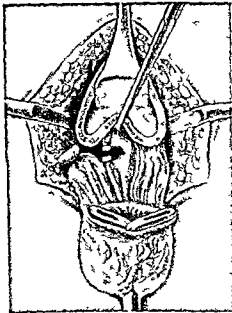


FIG 373 Excision of carcinomatous prostate The seminal vesicles and vasa are separated and divided (After H H Young)

ference unjustifiable. H. H. Young¹ placed the radical operation upon a sound foundation and says that his results "have been remarkably satisfactory." Fourteen out of twenty cases were alive and apparently free of recurrence three years after operation.² If the diagnosis is made soon, before the disease has invaded the bladder or urethra and in the absence of any signs of dissemination, the growth may be explored through the perineum and, if possible, removed with its fibrous sheath. The urethra is divided above the compressor urethræ and the bladder neck

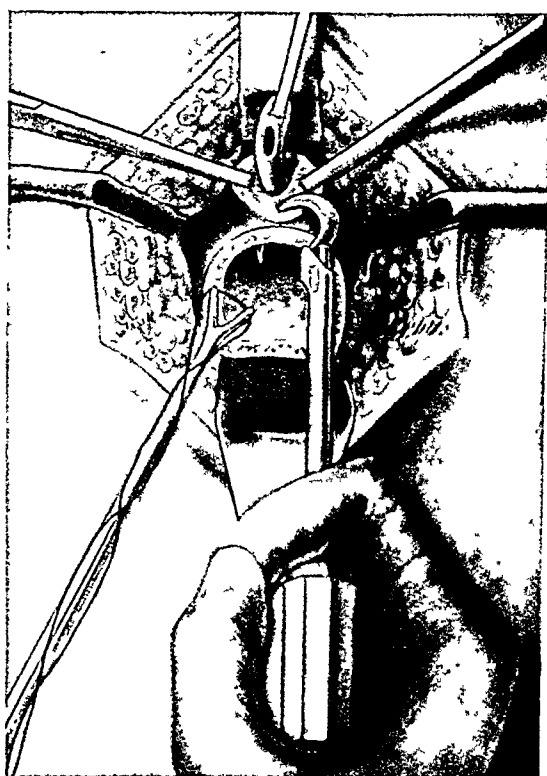


FIG. 374. Excision of carcinomatous prostate: anastomosis of the bladder with the membranous urethra begun. (After H. H. Young.)

above the growth and below the ureteric openings. After the urethra has been divided the prostate is separated by blunt dissection from the fascia in front of it which separates it from the important vessels and nerves in the space of Retzius which supply the compressor urethræ; if these are saved, urinary control is preserved and hæmorrhage is avoided. The bladder is then opened from the front, so that the ureteral orifices can be seen and avoided when the incision is carried through the posterior wall of the bladder. The seminal vesicles are removed with the prostate in one piece, and the neck of the bladder is partly closed by catgut sutures; the small opening left is sewn to the membranous urethra and a catheter is tied in for ten days. The perineal wound is drained.

¹ *Johns Hopkins Bull.*, 1905, xvi, 305-321; *Ann. of Surg.*, 1909, xlix, 1144-1233; and *Practice of Urology*, 1926, ii, 476.

² *Practice of Urology*, i, 634.

G Walker¹ with an experience of two cases, advocates the separation of the pubic symphysis to allow the adequate exposure and removal of the carcinomatous prostate. He first opens the bladder above the pubis to confirm the diagnosis and to find out if the growth is removable, he then divides the cartilage and ligaments joining the pubes and removes the prostate and its sheath as described above joining the membranous urethra to the posterior angle of the vesical wound which he closes after introducing a urethral catheter. He also drains the bladder above the

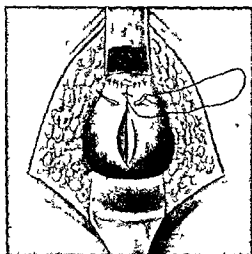


FIG 375 Excision of carcinomatous prostate. Anastomosis of the bladder to the membranous urethra and closure of the vesical wound. (After H. H. Young.)

pubis and wires the bones together. He keeps the patient at rest in a Bradford frame and supports the pelvis later by a binder. Both patients survived the operation but one developed a recurrence some months later.

(c) In late cases, either no operation is indicated or palliative supra pubic cystostomy may become necessary for retention of urine or for the relief of cystitis and hæmorrhage with painful frequent micturition when a catheter is difficult to pass or fails to relieve.

PROSTATIC ABSCESS

Prostatic abscess may be either acute chronic tuberculous, gonorrhoeal, septic or pyemic. Tuberculous abscess often occurs in the course of tuberculous disease of other parts of the genito urinary tract. Acute abscess generally gives rise to high temperature often with rigors, and, as a rule, a great deal of straining and difficulty in passing water, with acute retention sometimes, pain in the perineum and rectal tenesmus, occasionally there are no local signs but only high fever with rigors.

Treatment An acute abscess often opens spontaneously into the urethra or it may be perforated by the catheter which is introduced for

¹ *Ann of Surg* 1923 lxxviii, 795

retention of the urine. In other cases it opens into the rectum, but in some it burrows back into the ischio-rectal fossa and issues by the side of the anus. The perineal route is the best to choose for opening and draining the abscess and should be adopted, if possible, before the pus has burrowed about or has given rise to pyæmia. The abscess drains but poorly along the urethra, and its discharge in this direction may be followed in some cases by cystitis, urethritis or troublesome urinary fistulæ. When the abscess has burst into the rectum it generally drains well, but sometimes the opening closes or narrows and has to be dilated under an anæsthetic.

Operation. The patient is placed in a lithotomy position, and a curved incision, with the convexity forwards, is made as for perineal prostatectomy; the central point of the perineum is thus exposed and divided. Half this incision suffices when the abscess is unilateral. The levatores ani and rectum are separated by the finger and displaced backwards; the sheath of the prostate is exposed and incised on its posterior surface and the points of dressing forceps inserted and separated, thus opening the abscess, after Hilton's method. If the forceps are withdrawn directly the abscess is opened there is no fear of causing urethral fistula, but occasionally the abscess has already opened into the urethra. Drainage is necessary for some days.

PROSTATIC CALCULI

These must be distinguished from calculi descending from the bladder into the prostatic urethra and not uncommonly lodged there for some time. True prostatic calculi commence in the ducts of the prostate, which are often somewhat dilated and sacculated. They are rare and are generally found in men over middle age who have some obstruction in the urethra, which has caused dilatation and inflammation of the prostatic ducts. The calculi are generally small, but may sometimes be of considerable size. There may be hundreds of minute calculi in the prostate, some of them being polygonal with sharp angles. They are generally brown and sometimes almost black in colour. They often give rise to considerable enlargement of the prostate with some obstruction to the flow of urine from the bladder, pain and sometimes hæmaturia. Occasionally calculi form in sacculi opening directly into the prostatic urethra, or one may lodge in the anterior urethra and cause retention of urine. Prostatic are apt to be mistaken for vesical calculi, and some of them may be pushed back into the bladder by the introduction of an instrument along the urethra. As a catheter, and especially a sound, is passed into the bladder, the calculi are felt before the instrument slips into the bladder. X-ray examinations are somewhat difficult, but they have often demonstrated a multitude of small calculi in the prostate. Cystoscopic examination excludes a stone in the bladder and may reveal enlargement of the prostate.

Operation. A calculus lodged in the prostatic urethra is best removed by median perineal section, and true prostatic calculi have also been removed through a median perineal section (p. 636), finger and forceps being introduced into the prostatic urethra for the removal of the stones; but some of them may be left behind, so that recurrence is not uncommon.

In some cases the urethra has not been opened, but the stones have been removed through the posterior surface of the prostate, and this is a better plan for true prostatic calculi. This is done with the aid of Young's prostatic tractor used as in perineal prostatectomy. In some cases suprapubic or perineal prostatectomy is indicated, and it certainly has the great advantage of removing the factory and also overcoming the urethral obstruction and the associated cystitis.

Dr M., aged 76, had been remarkably healthy except that he had renal colic when quite a young man, and passed several stones. He also had a stone crushed by Sir Henry Thomson fifty three years ago. He had passed several small stones since then, and had had renal colic on both sides. During the last year he had been getting up about six times every night and having pain and frequency of micturition during the daytime as well. During the last few months Dr Mackern had been looking after him for cystitis, bleeding, occasional retention, pain in the glans and perineum, and some distension of the abdomen. He had found it impossible to pass a catheter, but a week ago, when urgent signs of retention came on, he was able to pass a sound, and felt a stone which he must have dislodged from the urethra, for the patient was very much better after it and passed two stones, and it was thought that an operation, which had been advised, would prove unnecessary. However, the symptoms returned during the week and the patient was a great deal worse and had very foul urine. No catheter could be passed. I saw him on March 1, 1913. He had to pass water about every half an hour, and slept very little. The bowels were also opened at the same time. He was very miserable, having to use morphia suppositories to get any relief. I found the bladder distended, passed a catheter and withdrew 33 oz. of urine, leaving some in the bladder. During the passage of the Coudé catheter I felt it passing over several stones. I ordered him some

Acid Sod Phos
Urotropine
Tinc Bellad

gr xv
gr x
gr xx

He slept for several hours continuously during the night, and on the 2nd he was removed to a nursing home. I washed his bladder out with bichloride of mercury 1:1000, and left 6 oz. of water in afterwards.

Operation on March 3, 1913, at 9 A M. The bladder was opened above the pubes and was found to be very large and fasciculated, but it contained no stones. The prostate was enlarged, being about three times its natural size. It was very hard and full of stones. On passing the finger down into the prostatic urethra these could be felt. They were hard, angular and projected into the urethra. I scraped through the mucous membrane at the back of the urethra, thus enlarging the vesical orifice, and dislodged about half a dozen large stones into the bladder. There were a great many more to be felt in the prostatic tissue, which I therefore enucleated in the usual way with two left fingers in the bladder and two gloved right fingers in the rectum. With difficulty I dislodged the prostatic stones into the bladder, removed the glove and proceeded to remove the stones from the cavity of the bladder. This proved to be very difficult as there were so many little stones scattered about. I washed out the bladder and a good many of them came out into the wound. A gauze roll was then passed into the bladder and many other stones came out with the gauze. When the bladder was quite clean a large rubber tube was inserted. The contracted bladder gripped it firmly. The patient did well. He passed some water in the natural way on the eighth day.

CHAPTER XXVI

OPERATIONS ON THE URETHRA AND PENIS

RUPTURED URETHRA

IN a few cases the surgeon may succeed in passing a catheter into the bladder, and he is most likely to do so by keeping the point along the roof of the urethra, for this is the part which most frequently escapes injury. When there is little or no bruising it is enough to secure a catheter in position to drain the bladder for about a week, but if any sign of urinary extravasation develop a free median incision must be made into the inflamed tissues without delay. If the instrument enter the bladder in a case where there has been much bruising ¹ of the perineum and extravasation of blood, a median incision should still be made to allow of relief of tension and escape of breaking down clots, and so give good drainage. If this is not done, the probability is great that a little later, owing to damage of soft parts, tension of blood clot and a little escape of urine by the side of the catheter, this step will be required at a time when, from the presence of septic fever and the condition of the extravasated blood and urine, the occasion is less favourable.² Again, though a catheter can be passed at the time, it by no means follows that when, owing to it being plugged or for some other reason, it requires removal in a few days, a fresh one can be inserted. An incision will then have to be made and, as already stated, under conditions less favourable.³

When, as is usually the case, a catheter cannot be passed into the bladder, the patient is placed in the lithotomy position and, the parts having been shaved and cleansed, a No. 10 gum elastic catheter with stilette is passed as far as it will go, *i.e.* to the site of the rupture, and held by an assistant.

The surgeon, sitting facing the perineum, makes a median perineal incision or, if the rupture is far back, a transverse or curved one for better exposure; the wound is gradually deepened.

With the finger clots are now turned out, and, retractors being inserted, the wound is sponged out thoroughly. A good deal of bleeding may take place from some wounded vessel, hitherto closed by extravasated blood, or from the crus penis, detached on one side by the violence which ruptured the urethra, especially if there be a fractured pelvis. This hæmorrhage will yield to firm pressure or to forci-pressure. The anterior

¹ Complete rupture of the urethra may co-exist with a mere contusion of the perineum, especially if much tenderness is present.

² Kaufmann (*Von Bergmann's System of Practical Surgery*), out of 44 cases, found that the catheter had to be removed in 22, for extravasation had occurred in 3. Perineal abscess had developed in 9, and extensive sloughing in 10; five of the patients died from these complications.

³ Mr. Rutherford (*Glasgow Hospital Reports*) advised suprapubic puncture in addition to any other procedure and described three cases in which he adopted this plan with advantage.

end of the urethra is next readily found by the end of the catheter, which projects through it. When only the floor of the urethra is divided the bruised edges are pared and brought together with catgut sutures. When the urethra is completely divided the finding of the deeper or vesical end, often difficult, will be facilitated by careful sponging and a head-light, pressure above the pubes and the use of fine probes or straight gum elastic catheters. The end is often indicated by adherent clot or bleeding point, at other times it resembles a partly twisted artery.¹

If it be found, the catheter in the anterior urethra is passed on into the bladder, guided by a finger in the wound, a Brodie's probe or a Teale's gorget (Fig 378). If this be found impracticable, a catheter should be passed into the bladder from the wound. One of these methods should always be made use of, if possible, as it enables the patient to be kept dry by tubing attached to the catheter.

But if no catheter can be got into the bladder, either through the penis or from the wound, the surgeon need not worry himself as long as a free exit has been given for the urine and extravasated blood. In these cases it is not unusual for the bladder to become somewhat distended during the first two or three days, owing to the urine not escaping with sufficient freedom, or to the closure of the vesical end of the urethra from swelling after the injury and the manipulations to find it, or from the patient, if a child, shrinking from passing his water. This difficulty will usually be met by hot flannels frequently applied to the abdomen and a few doses of laudanum, but if it be evident that the urine does not escape with sufficient freedom the surgeon must again examine the wound with the aid of an anæsthetic, clean out any fresh clots and again try to find the vesical end of the urethra, aided now, perhaps, by a better light.

If this fail, suprapubic tapping, aspiration or, if the patient's condition be good, making a small suprapubic opening into the bladder and thence passing a short curved staff into the perineum and so finding the vesical end of the urethra, must be resorted to.

Suture of the Urethra. It is always advisable, if possible to draw the ends of the urethra together on the catheter with a fine curved needle and catgut sutures. But this is often difficult, and sometimes impossible. Interrupted catgut sutures are used first on the roof of the urethra as the latter is drawn aside on the catheter. Then the sides and floor are sewn. A soft rubber catheter is used and this should not stretch the urethra where it is sewn. When suture is effected, it does not abolish the need of subsequent regular use of catheters, and the perineal wound must be drained for a few days in any case, however well the surgeon may have been able to sew the urethra. Accurate suture diminishes the risk of stricture, but in any case the risk of this must be remembered and a bougie passed regularly as long as there is indication of narrowing of the urethra.

OPERATIONS FOR STRICTURE

The majority of strictures of the urethra are best treated by gradual dilatation with catheters of increasing size tied in, but in some cases either external or internal urethrotomy has to be adopted.

¹ The farther back the tear, the greater, of course, the difficulty in finding the urethra.

EXTERNAL URETHROTOMY

This operation includes the different forms of perineal section with or without a guide, viz. Syme's, Wheelhouse's and Cock's operations.

Indications. This operation is recommended when dilatation and internal urethrotomy are inapplicable or ineffective.

(1) Impermeable stricture.

(2) Strictures which do not yield to dilatation, or rather continue to present symptoms after being dilated or divided—in other words, contractile, multiple, tubular, irritable and resilient strictures in which dilatation is accompanied with much pain, or which rapidly recur. These are usually cases of false passages at the side of the real stricture, the instrument having been forced through the urethral wall just in front of the constriction and then back again into the dilated urethra behind.

(3) Traumatic constrictions are sometimes very intractable and are often best treated by external urethrotomy.

(4) Cases in which rigors and constitutional disturbances follow any attempt at dilatation.

(5) When fistulæ, abscesses, extravasation, cystitis or stone in the urethra complicate the stricture, it is best to use this operation.

Wheelhouse's operation is far more often employed than that of Syme, for it is more generally applicable to all kinds of strictures, whereas Syme's operation needs a permeable stricture for its performance. Cock's operation is the most suitable for bad cases with acute retention, extravasation or multiple fistulæ and diseased kidneys.

Syme's External Urethrotomy. Here the stricture is divided on a fine staff (*vide infra*) passed through it.

Operation. The patient, having been prepared for the operation, is anæsthetised, and the surgeon introduces a Syme's staff. This has a narrow terminal portion which passes through the stricture, a shoulder which rests upon the face of the stricture, and a wider, stouter part above the shoulder to make the instrument easier to find in the perineum. The patient being placed in a good light, in lithotomy position, and the parts cleansed and shaved, the surgeon makes an incision exactly in the median line down upon the staff, exposing the wider portion above the shoulder. When the surgeon is certain that this is laid bare, he runs the knife forwards along the groove, so as to divide the stricture completely. The staff is now withdrawn, and a No. 10 gum-elastic catheter should be passed from the meatus into the bladder, guided by a finger in the wound or by a grooved director passed from the perineum.

The catheter should be kept in for a week or ten days if possible and only changed if it gets blocked. An attempt to flush the catheter with boracic lotion is often successful. Acid sodium phosphate and urotropine are administered to keep the urine sweet and acid, and if necessary the bladder is washed out daily with boracic lotion.

Wheelhouse's External Urethrotomy. Here the stricture is first found by a staff passed down to it, and then divided on a fine probe-pointed director passed through it.

Mr. Wheelhouse¹ recommended his method as having "the advantage of greatly increased precision. It renders an operation, confessedly

¹ *Brit. Med. Journ.*, June 24, 1876.

hitherto one of the most difficult in surgery a comparatively easy one and one which in my hands and in those of my colleagues has given results infinitely more favourable than we had ever seen before its introduction

Operation The patient is placed in lithotomy position with the pelvis a little elevated so as to permit the light to fall well upon it

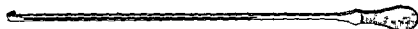


Fig 36 Wheelhouse's staff

The staff¹ (Fig 376) is to be introduced with the groove looking toward the surface and brought gently into contact with the stricture. It should not be pressed much against the stricture for fear of tearing the tissues of the urethra and causing it to leave the canal which would mar the whole after proceedings which depend upon the urethra being opened a quarter of an inch in front of the stricture. Whilst an assistant holds the staff in this position an incision is made into the perineum extending from opposite the point of reflection of the superficial fascia to the outer edge of the sphincter ani. The tissues of the perineum are to be steadily divided until the urethra is reached. This is now to be opened in the groove of the staff not upon its point so as certainly to secure a quarter of an inch of healthy tube immediately in front of the stricture. As soon as the urethra is opened and the groove in the staff fully exposed the edges of the healthy urethra are to be seized on each side with straight bladed nibbed forceps and held apart. The staff is then to be gently withdrawn until the button point appears in the wound. It is then to be turned round so that the groove may look to the pubes and the bottom may be hooked on to the upper angle of the opened urethra which is then held stretched open at three points thus (Fig 377) and the operator looks into it immediately in front of the stricture. While thus held open a probe pointed director² is inserted into the urethra and the operator if he cannot see the opening

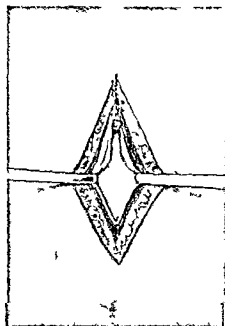


Fig 377 Wheelhouse's operation. The urethra has been opened in front of the stricture and the latter divided

This is fully grooved through the greater part but not through the whole of its extent the last half inch of the groove being stopped and terminating in a round button at its end

¹ Or a common blunt-pointed probe may be used. Occasionally a bougie (No 2 or 3) is useful

of the stricture, which is often possible, generally succeeds in very quickly finding it, and passes the point onwards *through* the stricture towards the bladder. The stricture is sometimes hidden amongst a crop of granula-

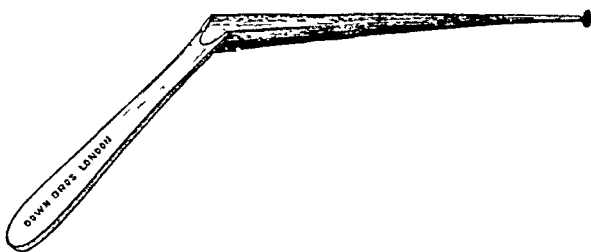


FIG. 378. Teale's probe-gorget.

tions or warty growths, in the midst of which the probe-point easily finds the true passage. The director having been passed into the bladder (its entrance into which is clearly demonstrated by the freedom of its movements), its groove is turned downwards, the whole length of the

stricture is carefully and deliberately divided on its under-surface, and the passage is thus cleared. The director is still held in the same position, and a straight probe-pointed bistoury is run along the groove to ensure complete division of all bands or other obstructions. These having been thoroughly cleared, the old difficulty of directing the point of a catheter through the divided stricture and onwards into the bladder is to be overcome. To effect this, the point of a probe-gorget (Fig. 378) is introduced into the groove in the director, and, guided by it, is passed onwards into the bladder dilating the divided stricture and forming a metallic floor, along which the point of the catheter cannot fail to pass securely into the bladder. The entry of the gorget into the latter viscus is signalled by an immediate gush of urine

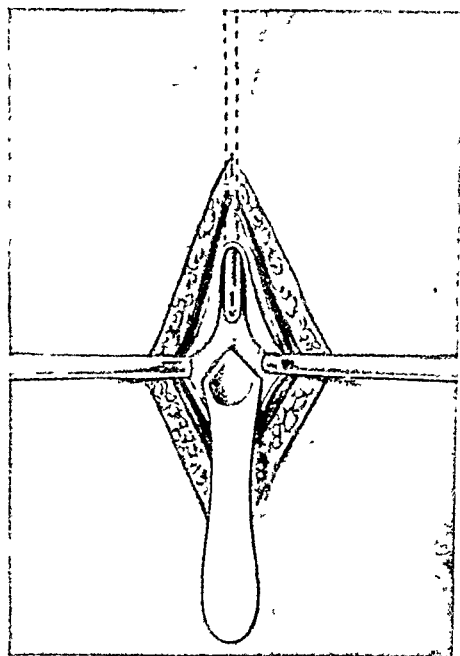


FIG. 379. Wheelhouse's operation. The probe gorget is used to guide the catheter into the bladder.

along it. A silver catheter¹ (No. 10 or 11) is now passed from the meatus down into the wound, is made to pass once or twice through the divided urethra, where it can be seen in the wound, to render certain the fact that no obstructing bands have been left undivided, and is then, guided by the probe-gorget, passed easily and certainly along the posterior part of the urethra into the bladder (Fig. 379).

¹ A soft catheter is better and safer to tie in.

The gorget is now withdrawn and the catheter fastened in the urethra." The latter is left in for ten days and, to prevent recontraction, it is passed again from time to time after the wound has soundly healed.

This will be found a most effectual operation, but in many cases the hitting off of the mouth of the stricture is a less simple matter than would be gathered from Mr Wheelhouse's account. This is especially the case when the parts are engorged and softened, as the free oozing which is met with under these conditions may be most difficult to arrest even with firmly applied sponges on holders, the slightest trickling of blood being sufficient to obscure the orifice of the stricture. A false passage at the site of the stricture may complicate matters very much and a stricture

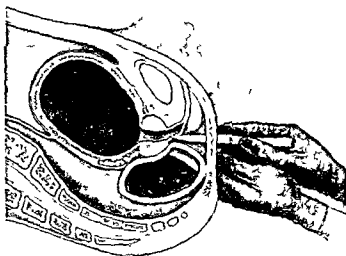


FIG 380 Cock's operation for acute retention of urine due to impermeable stricture of the urethra. The distended urethra is opened at the apex of the prostate, well behind the stricture and behind the compressor urethra.

in the penile portion of the urethra may prevent the passage of the staff altogether. A good light, gentleness and patience are at all times requisite.

Excision of Stricture. Occasionally a firm annular, nodular or traumatic stricture may be excised after König's method: the urethral ends being sutured as for ruptured urethra. In other cases a good deal of perineurethral scar tissue may be dissected away, with the object of lessening the chance of recurrence of the stricture. Grafting operations for the reconstruction of the urethra after more extensive resections or traumatic destruction have not been attended with encouraging success.

Cock's External Urethrotomy. This quickly and safely opens the distended urethra behind the stricture and without a guide (Fig 380). The following, in the words of its deviser, are the *advantages* of this operation, so well known to Guy's men.¹ "The bladder is reached without any unnecessary mutilation of the perineum. The communication is effected in nearly a straight line from the exterior to the cavity

¹ *Guy's Hospital Reports*, 1866, xii, 267

of the viscus, so that the cannula, which is inserted and retained, can be removed whenever necessary and can be easily replaced. The functions of the entire urethra are suspended and may be kept in abeyance for an unlimited period. The urine no longer finds its way abnormally through the stricture and sinuses of the perineum. The tissues are no longer subjected to constant irritation from infiltration. The constitutional symptoms are relieved, and time and opportunity are given for the removal by absorption of those adventitious products which obstructed the urethra, indurated the perineum and rendered the introduction of an instrument impossible. The pressure on the kidneys is removed and, if expedient, the bladder may be readily washed out, until its lining membrane assumes a healthy character. The strictured and damaged portion of the urethra, being no longer subjected to the constant pressure of urine from behind, may probably so far recover itself as to allow of restoration by the ordinary means of dilatation; or, should the canal have become permanently obliterated, the patient still retains the means of emptying his bladder through the artificial opening without difficulty or distress, and at very moderate inconvenience to himself."

The following are *the cases to which the operation is well suited*: where the stricture has existed for a number of years; where the urethra has become permanently obstructed or destroyed by the constant pressure of urine from behind and by reiterated attempts, generally fruitless, to introduce an instrument; where extravasation into the perineum has again and again taken place, causing repeated abscesses and their consequences, the formation of urinary sinuses and fistulæ, until the normal textures of the perineum become obliterated and are replaced by an indurated, gristly structure; where the bladder has become thickened and contracted by the constant action of its muscular coat until little or no cavity is left; and where the urine is constantly distilling by drops either through the urethra or through one or several fistulous openings, which dot the surface of the perineum, penetrate through the indurated scrotum and even find their way to the nates below and the region of the pubes above. If unrelieved, these cases invariably terminate fatally. Fortunately they are uncommon at the present day. *Cases of stricture with acute retention and extravasation of urine are very quickly and easily relieved by the operation, for the urethra is distended behind the stricture.*

The keystone of the whole proceeding is the fact that, "however complicated may be the derangement of the perineum and however extensive the obstruction of the urethra, one portion of the canal behind the stricture is always healthy, often dilated and accessible to the knife of the surgeon. I mean that portion of the urethra which emerges from the apex of the prostate—a part which is never the subject of stricture, and whose exact anatomical position may be brought under the recognition of the finger of the operator."

Operation. The patient is to be placed in the usual position for lithotomy; and it is of the utmost importance that the body and pelvis should be straight, so that the median line may be accurately preserved. The left forefinger of the operator is then introduced into the rectum, the bearings of the prostate are next examined and ascertained, and the tip of the finger is lodged at the apex of the gland. The knife¹ is then

¹ Cock's knife is double-edged.

plunged steadily, but boldly, into the median line of the perineum and carried on in a direction towards the tip of the left forefinger, which lies in the rectum. At the same time, by an upward and downward movement, the vertical incision may be carried in the median line to any extent that is considered desirable. The lower extremity of the wound should come to within half an inch of the anus.

"The knife should never be withdrawn in its progress towards the apex of the prostate, but its onward course must be steadily maintained until its point can be felt in close proximity to the tip of the left forefinger. When the operator has fully assured himself as to the relative positions of his finger, the apex of the prostate and the point of his knife, the latter is to be advanced with a section somewhat obliquely either to the right or the left, and it can hardly fail to pierce the urethra where the latter is distended and enlarged between the prostate and the stricture. If, in this step of the operation, the anterior extremity of the prostate should be somewhat incised, it is a matter of no consequence.

"In this operation it is of the utmost importance that the knife be not removed from the wound, and that no deviation be made from its original direction until the object is accomplished. If the knife be prematurely removed, it will probably, when reinserted, make a fresh incision and complicate the desired result. It will be seen that the wound, when completed, represents a triangle the base being the external vertical incision through the perineum, while the apex and consequently the point of the knife, impinges on the prostate. This shape of the wound facilitates the next step of the operation.

"As soon as the dilated urethra is opened, as indicated by a rush of escaping urine, the knife is withdrawn but the left forefinger is still retained in the rectum. The probe pointed director is carried through the wound and, guided by the left forefinger, enters the urethra and is passed into the bladder. A No. 12 gum elastic catheter, straightened on its stylet, is slid along the director, the stylet then removed, the catheter cut short and secured in position with tapes."

About ten days later catheters of increasing sizes are passed through the stricture into the bladder and tied in until the passage is well dilated.

After-treatment After external urethrotomy there is a tendency for the stricture to reform, therefore it is imperative to pass a bougie or conical sound of suitable size at regular intervals for at least a year.

Complications and Causes of Failure after External Urethrotomy.

(1) **Hæmorrhage** This may occur soon after the operation or at any time during the first fortnight. When severe the perineal wound is opened up and the bleeding vessel sought and tied, with the aid of a good light and irrigation. Antiseptic gauze is packed round the perineal tube or catheter draining the bladder, and firm pressure is applied by means of a perineal T bandage.

(2) **Cystitis and ascending nephritis** To prevent these the bladder is irrigated once or twice daily with a solution of oxycyanide of mercury (10000), and urinary antiseptics are given by the mouth.

(3) **Perineal fistula or sinus** This may last for some weeks, especially if much suppuration has preceded the operation.

(4) **Recurrence of stricture**

(5) Uræmia, bronchitis or pneumonia sometimes supervene in late and septic cases.

THE TREATMENT OF STRICTURE-RETENTION

When the obstruction is not quite complete or the need for relief very urgent, a few hours' rest in bed, opium, warm hip baths or fomentations often allay spasm and succeed in enabling the patient to pass water and to empty the bladder either partially or completely. Then, if not before, a small soft catheter (size $\frac{1}{2}$ to 3 silk web, or soft black) can generally be passed and tied in. The stricture soon dilates sufficiently to allow the urine to pass by the side of the catheter, if the latter fails to drain. Once he has succeeded in passing even the smallest catheter or bougie the surgeon must not remove it in the hope of being able to introduce a larger one, for he may then find that he cannot even reinsert the original one. After one or two days a larger instrument can be passed if used immediately after the withdrawal of the first one. Larger instruments can be tied in daily, or every other day, until the dilatation is completed by a No. 14 catheter.

The introduction of the catheter may be greatly aided by injecting a solution of adrenalin chloride ($\frac{1}{1000}$) with cocaine 2 per cent. into the urethra, to diminish the congestion of the mucous membrane at the stricture and to abolish tenderness of the urethra and the resulting muscular spasm. Distension of the urethra with warm sterile olive oil is also useful. The oil is kept in during the passing of the catheter by holding the meatus firmly around the instrument. The distension serves to remove folds of mucous membrane, to dilate the stricture slightly and especially to displace the orifice backwards, so that it lies at the apex of the funnel formed by the urethra in front of it. Without distension of the anterior urethra the stricture often projects forwards perhaps eccentrically into the lumen like an intussusception, so that a catheter fails to enter an opening which is quite large enough when its position is corrected.

Failing the introduction of a fine catheter, filiform bougies may be tried, and with perseverance one of these can be passed in most cases, with the aids mentioned above. The urethroscope may be useful in localising the orifice and also in conducting and introducing the bougie with the aid of sight. Sometimes a catheter can be passed upstream as the patient succeeds in voiding a little urine. Once a bougie has been got through the stricture, it may either be tied in or used as a guide for a "tunnel" or "railway" catheter to run along.

A conical silver catheter can be screwed on to a suitable bougie and slowly made to follow the latter into the bladder without any risk of making a false passage. The bougie coils safely within the bladder. This plan is far better than attempting forcibly to dilate a stricture with a metal catheter without any guide. In most cases such attempts either fail altogether or succeed only by making a false passage by the side of the real canal of the stricture. By keeping the point in the middle line a skilful surgeon may direct his instrument back again into the urethra where the latter is fortunately dilated behind the stricture, but although a good anatomist may succeed in entering the bladder and in affording immediate relief in this way, the method is too dangerous to be recommended for

general use and, moreover, the ultimate results are often poor, for the false passage usually retracts and obstruction returns sooner or later. Such false passages are sometimes misnamed resilient strictures.

In most cases where the patient is still comparatively young, where the stricture is not of long duration, where there are no urinary fistulæ or a damaged perineum, the retention can be relieved and the cure of the stricture started in one of the ways mentioned above, but in others all such attempts may fail, especially owing to the existence of recently made false passages and hæmorrhage from injudicious instrumentation.

It will have been gathered from the remarks at p. 597 that *suprapubic aspiration* may be used in very urgent cases and may be repeated safely once if necessary. For the large majority of cases of acute and complete retention due to impermeable stricture, especially when the patient is under 45 and a few days' rest will ensure the passage of a catheter, I believe that *suprapubic puncture of the bladder* will be the safest and simplest operation (p. 598). This will be followed in four or five days by the passage of a catheter, aided by an anæsthetic perhaps. Failing this, *Wheelhouse's operation* may be performed with great advantage.

INTERNAL URETHROTOMY

Indications. Before specifying these I would say that with regard to the question between external and internal urethrotomy or the need of either, it is chiefly a matter of personal experience. In other words, surgeons who practise usually some such operation as that of Prof. Syme—or use Mr. Wheelhouse's method—when careful dilatation aided by an anæsthetic fails, will probably have as good results as those who resort to internal urethrotomy. As it is a clean division of the entire stricture

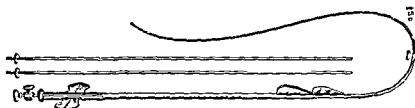


FIG. 381. Fergus's urethrotomy. This divides the stricture from below backwards.

which is required, this can be effected most readily, with less practice and with simpler instruments, by external urethrotomy; but internal urethrotomy has the great advantages of avoiding a urinary fistula, except as a very rare complication, and of saving much time. But it must be remembered that, after all, it is not so much the division of the stricture, whether from without or within, which will be curative, as the amount of perseverance which the patient shows afterwards. Again, at the commencement of internal urethrotomy each stricture must be dilated sufficiently to admit, in the case of an instrument cutting from before backwards, a sound equivalent to No. 2 English, while in instruments cutting in the opposite direction the bulb is as large as No. 4 or 5. This being so, the cases must be few in which the surgeon does not find it possible, and in

which the patient does not prefer, to complete the case by gradual dilatation.

Amongst these few cases are—(1) Strictures localised and annular, which (*a*) contract rapidly after dilatation, or (*b*) in which rigors persistently follow attempts at dilatation. (2) Non-dilatable strictures, *e.g.* some traumatic ones. (3) Penile strictures. These are very elastic, and shrink quickly after dilatation, and incision of these strictures seldom causes serious constitutional disturbance. (4) In some cases where time is an object. Thus, in young subjects whose disease has not existed long enough to alter the condition of the kidneys, cutting may be admissible for a stricture that should be simply dilated in an older patient whose kidneys have undergone degeneration.¹ According to some, urethrotomy affords a longer interval of freedom from contraction than does any other plan of widening a stricture. (5) When a stricture interferes with examination or treatment for stone or enlarged prostate, internal urethrotomy saves time. The urethroscope may occasionally afford useful information which may not only enable the surgeon to decide upon internal urethrotomy, but also indicates the exact direction and degree of the

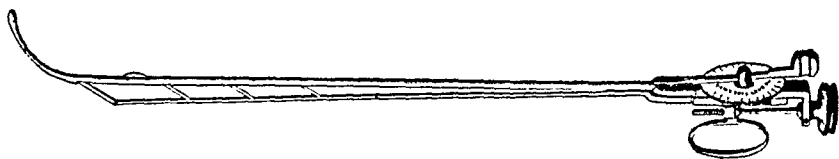


FIG. 382. Otis's urethrotome. This divides the stricture from behind forwards.

interference that is necessary. The operation can be carried out through the urethroscopic tube, with the aid of direct vision in some cases.

Contra-indications. (1) Strictures not localised and ring-like, but extending over a considerable surface. (2) A "stricture" in which the difficulty is mainly due to congestion, though this is scarcely a stricture at all. (3) Urethritis, or induration of the perineum with perineal abscess or fistulæ. (4) Ascending nephritis, especially when the blood urea is too high; here it is safer to drain the bladder freely by suprapubic or perineal cystotomy and to treat the stricture later.

In skilful hands the dangers of the operation are very small when aseptic precautions are carefully observed, the mortality being about 1·2 per cent. Consequently it has become popular, and it gives good results when the after-treatment is properly carried out.

The essentials of a good Urethrotome are: (1) a guide through the stricture into the bladder, usually in the form of a filiform guide-bougie or of a curved terminal portion of the urethrotome, sufficiently fine to pass through the narrowest stricture; (2) a cutting edge which, at first shielded, can be protruded by the surgeon exactly as he desires; (3) some means of steadying the mobile stricture fibres as they are divided.

Two chief Modes of Internal Urethrotomy. The stricture may be divided: (*a*) from before backwards, *i.e.* towards the bladder; (*b*) from behind forwards. It is generally divided from before backwards on the roof of the urethra, because much narrower strictures can be divided in this way. Most of the urethrotomes which cut from before backwards

¹ Berkeley Hill, *Dict. of Surg.*, ii, 727.

are modifications of Maisonneuve's pattern. A fine hollow staff being guided through the stricture by a filiform bougie, a stylet carrying a triangular shield or wedge is run along the hollow staff, this pushed against the stricture, serves to steady it while it is divided by a knife concealed in the wedge or shield. Some of the simplest and best of these modifications are those of Teevan (Fig 381) and Thomson Walker.

Those cutting from behind forwards are modifications of Civiale's urethrotome for their introduction the stricture must admit a No 4 bougie to allow the shielded knife to pass behind the stricture. This is a great disadvantage (Fig 382).

Operation After shaving and cleansing the parts thoroughly and irrigating the urethra with boracic lotion, the operation is carried out preferably under ether and oxygen anæsthesia but it can be performed under local anæsthesia following an injection of morphia ($\frac{1}{4}$ gr) given half an hour before the operation. Thirty to sixty minims of a 2 per cent solution of cocaine are injected into the urethra and retained for five minutes. The filiform bougie is passed through the stricture and its outer end is screwed on to the staff which is well oiled and it is pushed on until it is arrested at the stricture. The assistant now holds the staff steadily by its flanges at an angle of 45 degrees while the surgeon holds the glans with the left hand and passes the shielded triangular knife along the groove of the staff until it reaches the stricture which is divided by a sharp push. Any other strictures are similarly divided as the knife is pushed on. The latter is then gradually withdrawn and if any stricture still remains its division is completed by tugging. If necessary the process is repeated.

Large conical steel sounds (Nos 12 to 16) are then passed, and if at any point they are held closely, there is still some spot which needs retouching with the blade.

After-treatment A full sized catheter is tied in for two days other wise there may be a good deal of pain and difficulty in urination. After this the patient passes his water without difficulty. He is kept in bed for a week and the urethra is irrigated daily if urethritis develops. If the urine is offensive the bladder is washed out at the end of the operation and afterwards if necessary. On the tenth day a large sized conical sound (size 13 to 15) is passed and the patient returns once a week to have the instrument passed. After six weeks he need come only once a fortnight, and after another six weeks only once a month if no difficulty is encountered. If there is no contraction at the end of a year the patient may be regarded as cured.

Difficulties and Complications (1) It may be difficult or impossible to pass the necessary instruments. The filiform guide may break off and have to be removed from the bladder by means of a small lithotrite, which should be used without delay.

(2) Hæmorrhage, primary, reactionary, and especially secondary, may be troublesome and even dangerous. Perineal pressure against the catheter should be tried and also the intra vascular injection of calcium chloride 1 gr in 60 minims of water. If the bleeding continues the perineum must be incised, a large catheter introduced into the bladder and any bleeding vessels tied or the wound packed with antiseptic gauze.

(3) Urethral fever, perineal abscess, epididymitis and other septic

complications rarely occur when full antiseptic precautions are taken and the operation is reserved for suitable cases.

(4) Suppression of urine.

REMOVAL OF CALCULI FROM THE URETHRA

(1) A calculus obstructing the urethra may have descended from the bladder and is often renal in origin. Impaction of a calculus from this source is not uncommon in infants or young children as well as in adults. As a rule it becomes arrested in the penile urethra often just behind the glans.

(2) In older patients calculi sometimes form in the posterior part of the urethra behind a stricture.

(3) Prostatic calculi also invade the urethra.

A calculus impacted in the anterior urethra can be removed with forceps, perhaps after incising the meatus downwards. When the calculus is farther back and cannot be dislodged with forceps a longitudinal incision should be made directly over it, and the urethra sewn up with interrupted catgut sutures, which do not pierce the mucous membrane. The skin is sewn with interrupted sutures, a temporary drain being left between the sutures to guard against extravasation.

When a calculus is impacted behind a stricture, the latter must be treated at the same time. External urethrotomy is performed after Wheelhouse's method and the calculus is extracted with forceps. This may be very difficult in some cases. If there is much cystitis or induration with fistulæ or abscesses in the perineum, the bladder must be drained for a few days through the perineum, and when the wound is clean a catheter is passed through the penis into the bladder and tied in.

Calculi in the prostatic urethra, when they cannot be pushed back into the bladder with a sound, evacuated or crushed and evacuated, are best removed through a median perineal incision, the urethra being opened on a sound and the stones removed with long forceps. When large and projecting into the bladder it is safer to remove them by suprapubic cystotomy.

HYPOSPADIAS

Varieties. These are three, viz.: (1) Glandular. The opening is merely farther back than usual; the frænum is absent, the glans broad, flattened, somewhat recurved, and the prepuce, often hood-like, always in a condition of partial paraphimosis. (2) Penile. Here the urethra is especially liable to open at one of the three following sites: (*a*) just behind the glans; (*b*) at the middle of the penis; (*c*) at the junction of the penis and scrotum. (3) Scrotal. Here the cleft on which the urethra opens may be either at the junction of the penis and scrotum or involve the scrotum and perineum, the former being called peno-scrotal and the latter perineo-scrotal.

When an operation is under consideration, with a view of rendering micturition and coitus normal, the surgeon must take into due consideration: (*a*) the degree of the deformity; (*b*) whether the penis is fairly developed; (*c*) whether it is much tied down; (*d*) whether the testicles are present and descended; (*e*) how far the patient's condition is made

miserable by rawness and eczema due to impeded micturition and by impeded coitus and how far there are reasonable hopes of remedying these

In many cases when there is no recurvation and the urethra opens freely just behind the glans penis function is not compromised and there is no need to do anything beyond removing the hooded prepuce unless the patient or his parents desire to have the appearance corrected. When the meatus is too small it is necessary to enlarge it by incision to prevent pain and backward pressure.

Time for Operation The parts are so small and delicate that it is rarely wise to operate until the child is six years of age and it is often wise to wait still longer but not until after puberty owing to troubles and

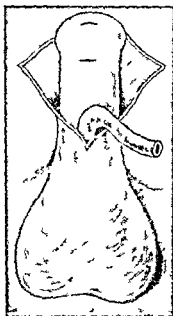


FIG. 393 Beck's operation

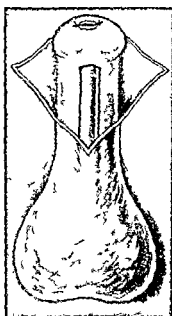


FIG. 394 Beck's operation

difficulties arising from excretion after the operation. In severe cases it is necessary to drain the bladder suprapubically and to straighten the penis before attempting to make a new anterior urethra. Unless the urine is diverted it may seriously interfere with the healing of the flaps. In some minor cases a catheter draining the bladder through the urethra suffices. Temporary suprapubic cystostomy is more satisfactory than perineal cystostomy because it diverts the urine more certainly and completely it can be carried out immediately before the plastic operation on the urethra. It is necessary however to straighten the penis and to wait until the wound is soundly healed before attempting the plastic operation. A transverse incision is made on the under surface of the penis in front of the abnormal urethral orifice and carried deep enough to allow the penis to be easily straightened. The glans is then sewn to the skin above the pubis and the penile wound is sewn up longitudinally.

Operations for the slighter deformities will be considered first

(1) **Beck's Operation.** This is suitable when the misplaced meatus is only a little way behind the glans. I have found it very successful in such cases.

The distal part of the urethra is isolated and mobilised as shown in Fig. 383, so that it can be brought forwards and sutured either to the urethral groove on the under-surface of the glans or the anterior end of a perforation made in the latter. The skin is then sutured over the urethra (Fig. 384).



FIG. 385. Van Hook and Mayo's operation.

is left attached at its base near the corona of the glans, and its edges are sewn together, so that a tube lined with skin is formed (see Fig. 385).

A tunnel is then made with a narrow-bladed knife, which is passed through the glans, above the urethral groove, and out near the misplaced urethral orifice near the root of the penis. The new-formed tube is then drawn through the tunnel and fixed with sutures both at the glans and at its exit (see Fig. 386). The gap upon the dorsum of the penis is closed. About ten days later the base of the flap is severed just in front of the glans, and a new meatus is thus formed.

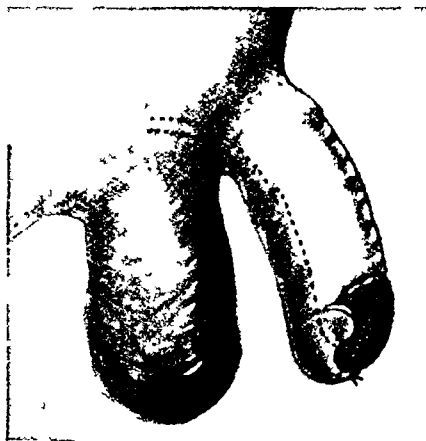


FIG. 386 Van Hook and Mayo's operation.

At a second operation the urethra is opened in the perineum, and a self-retaining female catheter inserted (see Fig. 387) and left in for about a week. The extremity of the old urethra is mobilised and implanted into the open end of the new part, and the skin wound closed. As some urine often leaks into the urethra in front of the catheter, it is well to pass several strands of silkworm gut or horsehair through the urethra and out alongside the catheter in the perineal opening.

(3) **Bucknall's¹ Operation** I venture to quote Mr Bucknall's own account of this operation "The penis is drawn up over the abdomen in the middle line and the scrotum is drawn down in the opposite direction *between the thighs* so that the groove, usually present in such cases, on the under surface of the penis the false meatus urinarius and the scrotal raphé all occupy the median line (Fig 388) Two similar incisions are now made on each side of the median line one eighth of an inch from it and parallel to it Each begins on the glans penis and is continued down the penis until opposite the misplaced urethra at its root Each incision is now prolonged on to the front of the scrotum on each side of the scrotal raphé and parallel to it, until the incisions on the scrotum measured from the level of the misplaced meatus are equal in length to those on the penis

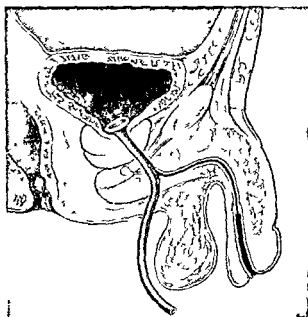


FIG 387 Van Hook and Mayo's operation

measured from the same point to the point of their commencement on the glans penis When these incisions are completed a median strip of skin a quarter of an inch in width is mapped out, reaching along the upturned ventral surface of the penis and the front of the scrotum with the misplaced meatus at its centre From the extremities of the two incisions bounding this strip of skin others are now made outwards at right angles each a quarter of an inch in length (Fig 388) In this way two longitudinal flaps are marked out on either side of the median strip of skin throughout its whole length These flaps are dissected up off the sides of the penis and front of the scrotum respectively, and rolled outwards away from the middle line throughout their whole length (Fig 389) Two long strips each presenting a raw surface half an inch wide, are thus produced on either side of the median strip of skin previously referred to, which is left undisturbed The flaps are held in the

¹ *Lancet* 1907, ii, 887

everted position with forceps throughout their whole length, and while in this position the penis is flexed down on to the scrotum in the middle line about a transverse axis passing through the misplaced urinary meatus (Fig. 389). The median strip of skin on the ventral aspect of the

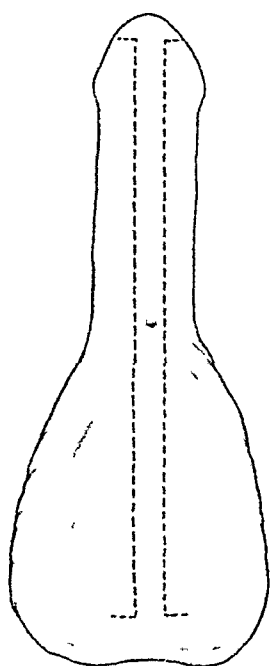


FIG. 388. Bucknall's operation for hypospadias.

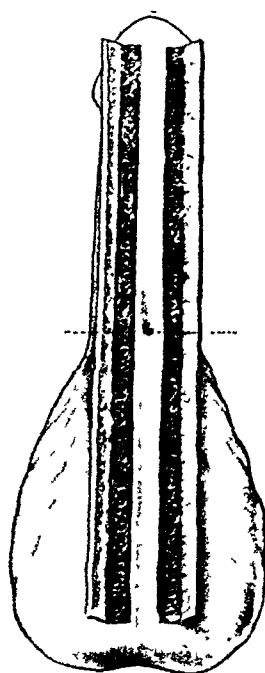


FIG. 389. Bucknall's operation for hypospadias.

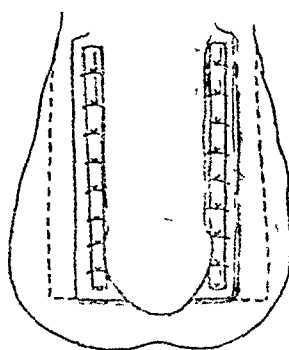


FIG. 390. Bucknall's operation for hypospadias.

penis and the raw areas flanking it thus come to lie on the corresponding median strip and raw surfaces on the front of the scrotum. The penile strip of skin will form a roof for the new urethra and the scrotal strip will form its floor. The raw surfaces on each side, when properly sutured, will cohere and grow together, fixing the penis to the scrotum and closing in the lateral aspects of the new urethral tube so as to render it watertight. The parts now present the following appearance. The penis lies

on the front of the scrotum in the middle line like a complete web penis, and on either side where they come together the opposed penile and scrotal flaps project so as to form a flange about a quarter of an inch in width, which extends from the root to the tip of the penis. The penile and scrotal flaps forming each lateral flange are now sutured together in a special way. Each flange is transfixed by the needle, close to its free edge, and the needle is then reversed and passed through the flaps forming the flange in the opposite direction quite close to the attached borders of the flaps composing it. In this way a series of sutures are inserted at intervals of a quarter of an inch from the root of the penis to its tip, each running transversely to the axis of the penis, across the skin surfaces of the penile and scrotal flaps (Figs 390 and 391). In passing each suture through the attached base of the flap special care is taken that the needle almost, but not quite, takes up the edges of the strips of attached skin, which will form the roof and floor of the new urethra, for it is important to approximate the epithelial margins without the suture projecting into the new urethral lumen (Fig 391). All the sutures are passed before any are tied, and before tying them two special manoeuvres are carried out: (1) small rubber tubes are passed under the sutures on the front and back of each flange to avoid puckering of the skin and to keep up pressure over a broad area between the opposed raw surfaces of the flaps, and (2) a small rubber catheter, with the eye cut off is passed along the track which will form the new urethra and pushed a short way down the previously formed urethra so as to drain off the urine without soiling the newly constructed portion. A suture at the tip of the penis fixes the catheter in place. The parts are dressed with lead lotion every four hours. On the fourth day the piece of catheter is removed and urine is allowed to pass down the new urethral tube. The sutures are all removed at the end of fourteen days and the parts are ready for the second operation in from three to four weeks if the patient's condition is still favourable. Otherwise the second operation can be postponed indefinitely.

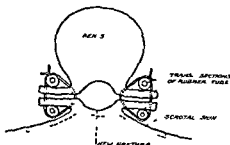


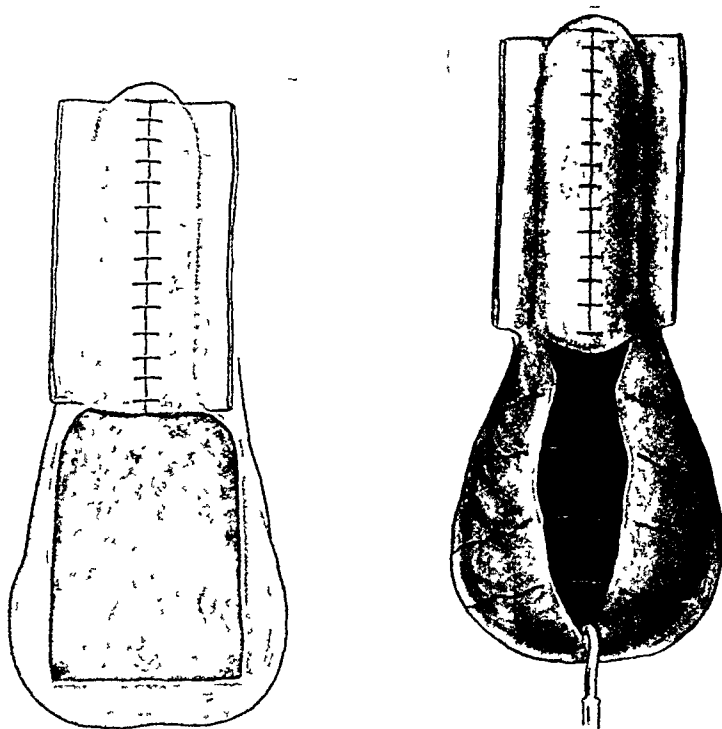
FIG 391 Bucknall's operation for hypospadias. Transverse section of the penis and urethra.

“Operation, Second Stage The penis and new urethra are dissected up from the scrotum, lateral flaps derived from the scrotum being left attached on either side of the penis to close in the raw surface beneath it (Fig 390, dotted line, and Fig 392). Other flaps are formed on the scrotum, and by gliding them towards the middle line the raw surface on the front of the scrotum is easily closed (Figs 392 and 393). If the lateral flanges used to unite the penis and scrotum in the first stage are seen to project too freely, they can be trimmed off either now or later to improve the cosmetic result.”

The late Mr Bucknall recorded three cases in detail. The first two cases had been watched for five years and the third for two years. The

cosmetic and functional results were as good and satisfactory in every way as could be desired. All the wounds healed without delay and there was never any leakage or tendency to stricture.

“The advantages which may be claimed for this method of operating are as follows: (1) That it is performed in two stages, each of which can be rapidly accomplished. This lessens shock and enables the operation being done at an early age, the ultimate plastic result being all the better in consequence. (2) That the skin utilised to form the roof and floor of the new urethra is not dissected up or even touched, consequently it retains its vitality and does not tend to slough as when flaps are used for



FIGS. 392 and 393. Bucknall's operation for hypospadias.

this purpose. (3) That no sutures project into the lumen of the new urethra. (4) That the skin of the roof and floor of the new urethra is respectively in continuity with the roof and floor of the previously existing one. There is in consequence no tendency to the formation of a fistula or subsequent stricture at the site of the false meatus as so frequently happens when other methods are employed. (5) No buried sutures are necessary and the apposition of the broad raw surfaces afforded by the flaps on either side, supported by the rubber tubes, prevents any tendency to leakage.

“The disadvantages to be considered are two in number: (1) that the operation is only applicable if the scrotum is uncut; and (2) that hair may possibly grow later on in life from the skin of the scrotal raphe which is used to form the new urethral floor. The former disadvantage

is minimised by the fact that by far the larger number of cases of hypospadias are of the penile variety, and that should the scrotum be cleft as well, the greatest trouble is not so much due to the deformity as to incontinence of urine which is incurable

Hamilton Russell's operation¹ is also a good one which was fully described in the 5th edition of this book

EPISPADIAS

The introductory remarks concerning hypospadias apply almost equally to this much rarer deformity (p 710) The roof of the urethra is deficient or absent, the abnormal opening being usually situated on the dorsum and close to the root of the penis In all cases of ectopia vesicae epispadias is a part of the deficiency The penis is small recurved and may lie in contact with the pubis or abdominal wall The operation first described by Cantwell² is probably the best Perineal cystostomy is performed after passing a finger or sound through the urethra into the bladder to push the latter downwards towards the perineum An elliptical incision is made including the abnormal urethral orifice and the groove extending forwards from it to the tip of the penis This wide piece of altered mucous membrane is dissected up and its lateral edges are later sewn together so as to form a new urethra continuous with the old one The corpora cavernosa are easily separated in this condition, and the new urethra is then placed between and below them and secured there by sutures tied on the under surface of the penis The corpora cavernosa are sewn together above the urethra and finally the wound on the dorsum of the penis is closed A catheter is left in the urethra for several days Young³ leaves the mucous membrane of the new urethra attached to one corpus cavernosum which he rotates sufficiently to bring the urethra towards the lower surface of the penis (Figs 394 to 397)

In many cases epispadias and ectopia vesicae co-exist, there are all degrees of deficiency of the anterior wall of the bladder and urethra up

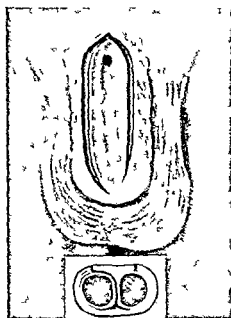


FIG 394 Operation for epispadias Lateral flaps are raised from the dorsum of the penis and the corpora cavernosa are separated (After Cantwell)

¹ *Brit Med Journ* 1900 ii 143°

² *Ann of Surg.*, 1895 xxii 689

³ *Journ Urol* 1918 ii 237

to complete ectopia vesicæ. In some cases the cleft extends from the meatus through the sphincter of the bladder. The following is a case of this kind.

Case of Incontinence of Urine Associated with Epispadias.¹ A boy, æt. 6, was sent to me early in June 1908 by Dr. B. A. Richmond, of Bermondsey, for incontinence of urine associated with epispadias. He was able to retain the urine fairly well while lying down at night, but directly he either stood or sat up it ran away. Throughout the day the water dripped into the clothes, keeping the trousers constantly wet and rotting them in a short time. Dr. Richmond wrote that "complaints were made at school that the boy was undesirable, because his clothes smelt so strongly. I hope that you will be able to recommend something to relieve a very distressing condition. The question is, can any plastic operation be done?"

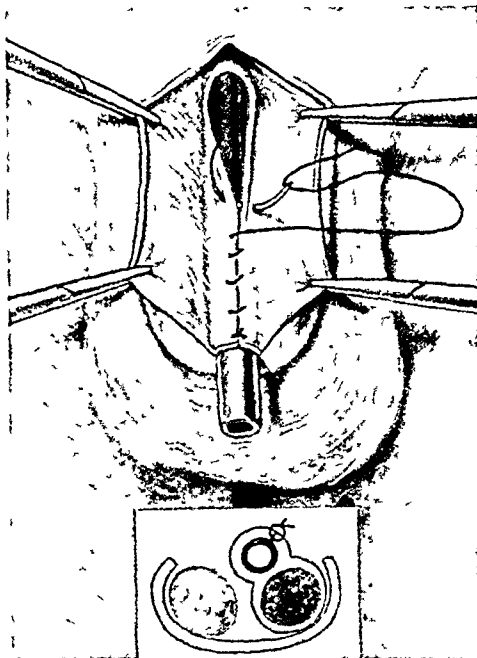


FIG. 395. Operation for epispadias. The edges of the dorsal flaps are sewn together to form the new urethra which is left attached to one of the corpora cavernosa. (After Cantwell.)

In other respects the boy was well developed, except that the right testicle was retained in the inguinal region, and that the symphysis pubis was depressed and thin. The penis was so extremely small, that only a little bud presented below the arched lower border of the pubic skin. The epispadias was nearly complete, but the cleft did not extend quite into the bladder, the posterior end of the urethra being roofed over with mucous membrane only.

Diagnosis. It was obvious that the bladder was of fair size, because it was capable of holding all the urine secreted during the night, if the boy kept supine. The complete incontinence in the vertical position proved that there could be no sphincteric control. Gravity, atmospheric pressure and the apposition of the mucous walls of the urethra were usually sufficient to prevent leakage while the trunk remained flat and the muscles at rest. It was concluded, therefore, that although the cleft did not extend into the bladder, the sphincter had failed to meet in front of

the urethra and the neck of the bladder. It was hoped that some of the muscle fibres existed, but that they were powerless because they did not encircle the urethra.

Treatment. In considering the treatment of this boy it was clear that it would be almost impossible to fit him with a urinal that would both keep him dry and make him "desirable" at school. It seemed to me that it was worth while for this boy to run a considerable risk in order to be rid of his incontinence, and to be saved from a pestilent urinal as a permanent necessity. I therefore recommended an operation, although the chances of complete success did not seem to be good. If the operation should fail a urinal could be used, or the urine be diverted into the rectum in one way or another. In a few cases of epispadias with extension of the cleft through the neck of the bladder, Trendelenburg had been able to construct a moderate sphincter by carefully suturing the freshened and liberated edges of the cleft. This has only been possible after mobilising the sacro-iliac synchondrosis so

¹ R. P. Rowlands, *Medical Press and Circular*, January 27, 1909.

that the pubic bones could be brought together and wired

Operation At the end of July 1908 a lateral flap with its convexity to the right was raised from the thin cartilaginous symphysis which was then divided vertically. The neck of the bladder and the short urethra were carefully separated from the pubic bones which were retracted leaving a gap of nearly an inch and a half between them. The subperitoneal fat was drawn up and the lower part of the bladder and the urethra were freely and carefully separated from their lateral attachments by blunt dissection. When the bleeding had been checked no muscular or prostatic tissue could be seen in front of the neck of the bladder or urethra whose anterior wall consisted of mucous membrane only. This was carefully saved. The lowest part of the anterior wall of the bladder was also very thin and almost devoid of muscular fibres.

By means of Lembert sutures of fine catgut the muscular and fibrous tissues upon the sides of the urethra and the lower part of the bladder were brought together in front of the carefully preserved mucous membrane which was thus invaginated. In this manner the passage was so narrowed that it firmly gripped a No. 4 self-retaining rubber catheter which had been inserted. The lateral separation had been free enough to prevent undue tension upon the sutures. The edges of the pubic bodies were freshened and fixed in apposition by means of wire. The wound was accurately closed. At first all the urine drained away through the catheter but this became blocked and had to be changed after the fourth day. When the instrument was finally removed there was incomplete control of the urine both day and night but gradually the incontinence diminished. Firm union occurred between the pubic bones and the gap was perfectly natural. No attempt was made to correct the epispadias this being deferred until the patient is older.

The boy soon gained full control of the bladder and when last seen he was fully grown and so satisfied with his condition that he did not wish to have the epispadias corrected.

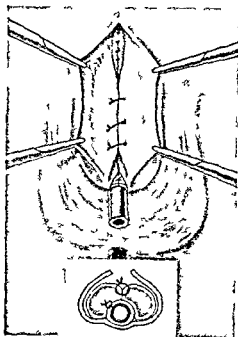


FIG. 396. Operation for epispadias. The urethra is brought down by rotating one corpus spongiosum. The corpora are then joined above the urethra. (After Cantwell.)

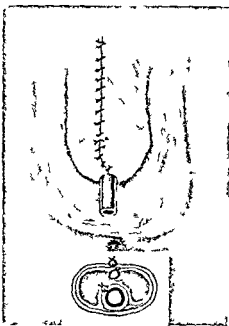


FIG. 397. Operation for epispadias completed. (After Cantwell.)

A. R. Thompson¹ has successfully made a sphincter for the bladder from some of the lower fibres of the rectus abdominis in similar cases of epispadias and minor degrees of ectopia vesicæ. He makes a deep circular incision around the abnormal urethral orifice and joins this by a long vertical incision over the right rectus abdominis, the fibres of which are divided 1 inch below the umbilicus and split; one half of them are carried on either side of the urethra, and joined together below it and also to the tissues around the urethra. The attachment of the muscle to the pubis, its blood and nerve supply are carefully preserved (Fig. 341).

Mr. Thompson has had several successful cases, and wrote to us in 1925 as follows: "I think the operation has good promise but needs very careful after-training in order to establish a reflex action out of what must at first be a voluntary action." For some time the patients may wet the bed once or twice a night, but during the day they can retain the urine for several hours and then pass a good stream.

CIRCUMCISION

Trivial as this operation seems, it is so important, especially in adults, to secure speedy healing, that it will be briefly alluded to here.

Indications. (1) Phimosis and paraphimosis and their results, such as balanitis; (2) warts on the prepuce or glans.

The operation can be performed in adults under local anæsthesia (novocaine 1 per cent.), but general anæsthesia is preferable in children; in infants it is safer to dispense with an anæsthetic, which is unnecessary and is not used in the religious rite.

For this and other reasons the sooner the operation is performed the better, preferably during the second or third week after birth. At this time the operation, with due aseptic precautions, is a trivial one, causing little pain and followed by small risk of hæmorrhage or other complications. The prepuce is cut off with a sharp knife and most of the mucosa is turned back as a cuff over the skin of the penis and fixed there by ribbon gauze, neither ligature nor suture being necessary. In all cases the following points must be remembered:

(1) Not to leave too much tissue about the frænum. Sir Henry Howse² has drawn attention to the fact that the cellular tissue at this spot is loose, and that the presence of the frænal artery makes probable the gathering of blood and inflammatory effusion at this spot. In children this is a matter of less importance, but in adults it may lead to the formation of a tediously persistent lump, interfering with the function of the organ.

(2) Not to remove too much of the prepuce. Thus it is always well, in adults especially, to leave enough to cover easily the sensitive papillæ with which the corona abounds. Again, in the diminutive penis of fat infants it is very easy to remove so much as nearly to flay the body of the organ.

The following is a very simple mode of operation: The prepuce having been separated as much as possible from the glans with the finger and

¹ *Lancet*, 1920, ii, 790, and *Proceedings Royal Soc. of Med.*, 1921, xiv, Section of Urology, 57.

² *Guy's Hospital Reports*, 1873, xviii, 239.

thumb or a stout probe a pair of dressing forceps is lightly placed on the penis a little in front of the corona, the glans being next allowed to slip back the forceps are closed and all the prepuce in front of the instrument is cut off with a sharp scalpel used with a rapid sawing movement. The following directions given by the late N. Davies Colley¹ are worth remembering at this early and most important stage of the operation. The incision should begin upon the dorsum at a point corresponding to that part of the glans which is half way between the meatus and corona. The incision should be made downwards and forwards so as to leave a sharp point in the middle of the under surface (Figs 398 399). The object of this pointed projection is to fill up subsequently the triangular interval which is otherwise left when the portion of the mucous membrane of the prepuce to which the frænum is attached is removed. The blades being at once removed the mucous membrane is then slit up with a director and scissors² this incision running up to but not beyond the corona. The mucous membrane if still adherent must be peeled in two flaps from the glans this detachment being best effected by the finger and thumb or by a stout probe swept round. The cut edges of the prepuce are then rounded off with scissors which follow the curve of the glans as far as the frænum. Just a frill of mucous membrane and no more should be left all the way round the corona (Fig 400). Enough prepuce should be left to cover over the corona papille and to admit of easy stitching. All bleeding must be stopped especially in adults or extravasation of blood in the loose connective tissue leads to tension cutting through of sutures and sloughing. By drawing the skin backwards with the left hand the bleeding arteries

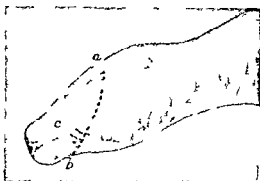


FIG 398 a b Shows the line of incision by which the prepuce is removed c The point of constriction of the mucous membrane which causes the phimosis. The finer dotted line shows the mucous membrane lining the prepuce and covering the glans (Davis Colley)



FIG 399 The pointed process of skin (b) shown adjusted in the angle left by the remains of the frænum. The dotted line (b d e) shows the edge left on the skin and the triangular bare surface which has to heal by granulation unless precautions are taken to preserve the triangular flap of skin as directed above (Davies Colley)

are exposed, picked up with forceps and tied with fine catgut. This systematic search for and tying of the bleeding points saves much possible trouble and annoyance from reactionary hemorrhage. The frænal and the two dorsal arteries usually have to be tied. Fine

¹ *Guy's Hospital Reports* 1897 xlv 164

² It is well at this stage to make tension on the loose prepuce with two pairs of dissecting forceps, and thus secure a clean section

needles should be used, and catgut sutures passed quickly through skin and mucous membrane with a stabbing movement, and without bruising the edges with forceps. In passing the sutures any bleeding-points must be transfixed, and the abundant cellular tissue kept in its place with the point of a probe. This cellular tissue must on no account be cut away, as in it run the vessels to the prepuce. The frænum is now attended to, the prepuce which is still attached here being cut away

carefully by V-shaped cuts, pointing forwards, and leaving just enough flaps to carry the sutures and no more.

I much prefer interrupted sutures of catgut for circumcision, one or two of which can be removed, if needful, without interfering with the rest. The majority soften away. A continuous suture constricts the penis when swelling occurs and is very uncomfortable.

Ribbon gauze soaked in sterilised liquid paraffin is

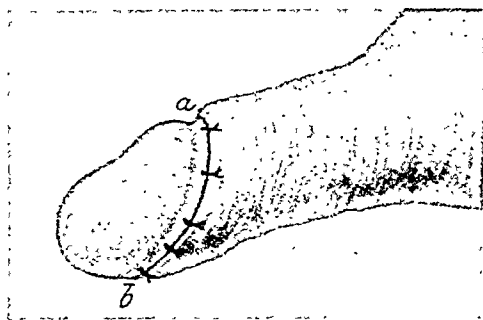


FIG. 400. The penis after the edge of skin has been sutured to the frill of mucous membrane left along the corona. (Davies-Colley.)

wrapped round the wound and corona, for this stops any hæmorrhage well. A pad of aseptic wool is then placed over the penis and kept in position by the pyjamas or diaper. This protects the sensitive glans and the wounded penis from injury and irritation. The dressing falls off in a warm bath daily and is renewed afterwards. Erections are sometimes troublesome in adults, but may be prevented or relieved by giving bromide of potassium gr. xxv with tincture of hyoscyamus ℥xxx in the evening and repeating the dose if necessary every four hours.

After circumcision the patient should rest as much as possible. Thus an adult should stay in bed for forty-eight hours and keep on the sofa for a week, alternate stitches being removed at intervals. If he insist on getting about too early, he must run the risk of the parts remaining long œdematous and tender.

AMPUTATION OF THE PENIS

Indication. *Epithelioma of Penis.* Any suspicious excoriation, ulceration or wart should be early destroyed, with the acid nitrate of mercury, or excised, and the base of any wart removed should be examined microscopically. Where, after this treatment, satisfactory healing does not take place, early and thorough removal of the part should be performed. There should be no dangerous waiting because the surgeon is unable to satisfy himself whether the case is one of inflammatory induration or infiltration from new growth. In such cases, especially where there is a doubtful history of syphilis, much valuable time has been often lost with drugs, which, even if the lesion does date back to some long-past syphilis, are quite useless if epitheliomatous ulceration has set in. Furthermore, the longer ulceration continues, the more extensively will the inguinal glands be involved. In such cases, though the penis may be satisfactorily operated upon, disappointment will speedily follow, owing

to the outbreak in the inguinal regions. Scarcely any surgical case presents a course more distressing, both to the patient and those around him, than one of breaking down of epitheliomatous glands, owing to the hideous ulceration, the noisome discharge and the steady decay of bodily strength.

In a very few cases, when the disease commences around the meatus, it may still be possible to remove the affected part without interfering with the body of the penis. It seldom happens, however, that we see the case early enough for this, and it is usually necessary to remove the whole of the glans and more or less of the corpora cavernosa. Before doing this the prepuce, unless it admits of being retracted, should invariably be laid open so as to expose the growth and make quite sure of its

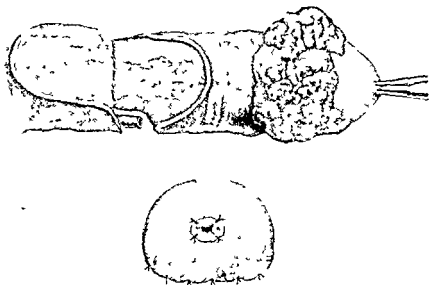


FIG. 401. Flap amputation of the penis. The appearance of the stump with the urethra slit up and stitched *in situ* is shown above.

real nature. The parts should be cleansed, as far as possible, by shaving the pubis and applying fomentations to the penis for two or three days before the operation. When the patient is anesthetised, the surface of the growth is seared with the thermocautery to avoid septic and malignant infection of the wound.

Operations. (1) *Circular Amputation.* This gives good results, though not equal, in my opinion, to those which follow the flap method. The vessels being commanded by a rubber tubing used as a tourniquet, the skin is drawn a little forward to prevent any superabundance afterwards, and the amputation is effected by a single sweep of the knife. The vessels and the urethra are treated as directed below.

(2) *Flap Amputation.* This method was followed by rapid healing, and gave an excellently covered stump in the eleven cases in which Mr Jacobson made use of it. Hæmorrhage having been provided against by one of the above given means, the surgeon enters a narrow bladed knife,

at a point well behind the disease, between the corpus spongiosum and the corpora cavernosa, and then cuts forwards and downwards for about three-quarters of an inch. From this small inferior flap the urethra is dissected out. A flap of skin is now cut from the dorsum and sides of the penis, resembling in miniature the upper skin-flap in amputation of the thigh. This flap being held back, the corpora cavernosa are divided vertically upwards on a level with the point of transfixion. Any vessels which can be seen are now tied with catgut. On removal of the tourniquet

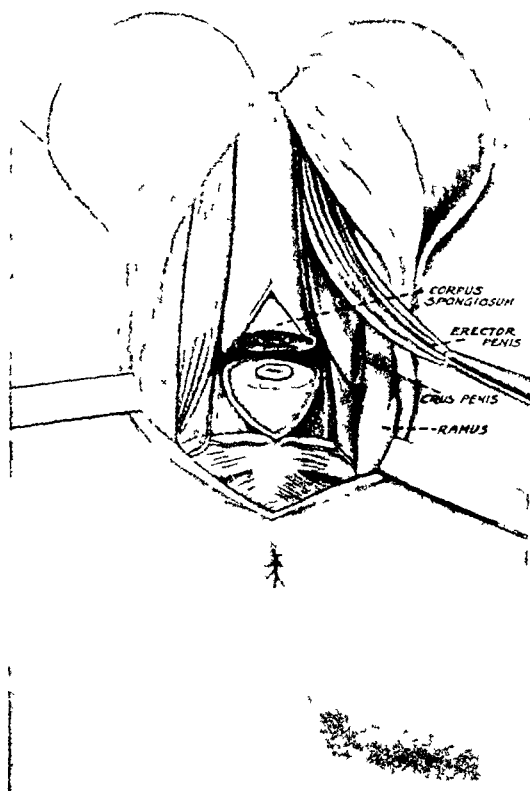


FIG. 402. Removal of the entire penis and its crura. The accelerator urinae and erector penis have been divided on the left side, and the corpus spongiosum and urethra have been severed a little in front of the bulb.

and securing any spirting vessels, free oozing often takes place from the corpora cavernosa, but it ceases spontaneously. All hæmorrhage being arrested, the upper flap is punctured, and the urethra drawn through the face of the flap, slit up and stitched *in situ*. The two flaps, upper and lower, are then united by a few sutures (see Fig. 401).

This method secures a natural skin-covering for the severed corpora cavernosa and prevents the delay and irritation which healing by granulation entails. A similar operation was long ago suggested by Prof. Miller, of Edinburgh, but this surgeon cut his flap from below. If, as Mr. Jacobson recommended, the flap is taken from above, the skin will be found to fall into position more readily over the raw surfaces of the

corpora cavernosa After all these operations the patient should pass a short piece of bougie at regular intervals

(3) *Removal of the entire penis and its crura* is occasionally necessary

Thus when the penis is involved as far back as the scrotum, the entire penis should be extirpated if the inguinal glands are not seriously involved and if the powers of repair are satisfactory The patient being in lithotomy position the scrotum is to be split deeply along the whole length of the raphé and the corpus spongiosum carefully dissected out This step may be facilitated by passing a large sound When the triangular ligament is exposed the above instrument is removed and the corpus

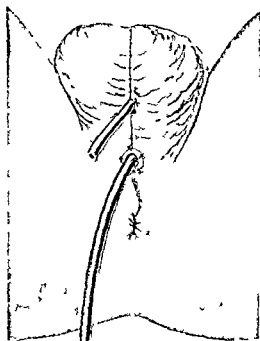


FIG 403 Removal of the entire penis The posterior tube drains the bladder through the urethra the anterior tube drains the large space left after removal of the penis

spongiosum which has been dissected out is cut through enough being left to bring out in the perineum (see Fig 402) By means of a blunt dissector the crura are then detached on either side from the pubic arch and the incision being prolonged around the penis above the suspensory ligament is divided and the dorsal arteries secured The cut end of the corpus spongiosum is now slit up and stitched in the posterior part of the scrotal incision and all the rest of the wound closed by sutures a small drainage tube being inserted a little in front of the urethra (see Fig 403) Similar operations to the above have been performed on several occasions but the important modification of dissecting off the crura and thus ensuring complete removal of the cancerous organ and its capsule was brought before the notice of English surgeons by Sir Pearce Gould¹

¹ *Lancet* 1882 i 871

In most cases of amputation of the penis the patients will be wise in consenting to castration—an operation which will add in many cases largely to their comfort, and at a very slightly increased risk.¹

Question of Removing Enlarged Glands. These should always be extirpated at the same time as the amputation of the penis, together with as much of the lymphatic vessels and surrounding cellular tissue as possible, preferably in one piece in order to avoid the escape of cancer cells into the wound. As long as the glands are involved by growth only, hard and separate from each other, it will be comparatively easy to accomplish this, and thereby add materially to the prolongation of the patient's life. But where they contain not only secondary deposits, but also inflammatory matter, owing to ulceration having set in at the seat of the primary lesion, satisfactory removal of the glands is always a matter of great difficulty and often impossible, owing to their softness and tendency to break down, to their adhesions to their capsules and the matting of these to the surrounding parts, the vascularity of which is increased, and tendency of the overlying skin to become adherent. When the growth becomes adherent to the femoral or iliac vessels, no attempt should be made to remove it, for the main vessels may have to be sacrificed, with resulting gangrene or œdema of the leg. The removal is very likely to be incomplete, and to be quickly followed by recurrence and hæmorrhage.

In all such operations especial care should be taken to ensure asepsis and to avoid laceration of the tissues.

Antiseptic dressings are the safest to use in this region.

Complications. (1) Hæmorrhage. This must be prevented by tying every bleeding vessel with care.

(2) Delirium or even insanity not uncommonly follow amputation of the penis in old men.

(3) Retraction and stenosis of the urethra.

Results. The mortality and recurrence are high after this operation, which is usually performed in old and debilitated men, but Butlin² found 35 per cent. of cases free from any sign of recurrence at the end of three years. One of us has a patient quite well ten years after complete removal of the penis for extensive epithelioma.

¹ Wheelhouse, *Brit. Med. Journ.*, 1886, i, 187.

² H. T. Butlin, *Op. Surgery of Malignant Disease*, 2nd ed.

CHAPTER XXII

OPERATIONS ON THE SCROTUM AND TESTICLE

RADICAL CURE OF HYDROCELE

WITH the great strides that have been made towards the perfection of aseptic surgery injection of irritants has become less and less common so that at the present time it is rarely performed. Under aseptic conditions excision of the parietal part of the sac is hardly more dangerous than injection and it is far more certain to cure. Moreover it is no longer necessary to use a general anæsthetic in all cases for safe and efficient regional or local anæsthesia suffices when the former is contra-indicated or declined. There are still many elderly patients however who wish for nothing more than the temporary and sometimes prolonged relief that simple tapping affords. Others decline all cutting operations. In these and under circumstances which are unfavourable for resort to radical operations injection may still be tried and therefore a description of this method is retained.

I Partial Excision of the Sac This is often spoken of as excision of the tunica vaginalis but only the parietal layer of the serous membrane can be removed.

This is by far the most certain method of cure. While it is right to remember that no method can be absolutely relied upon as radical and that hydroceles have recurred even after incision and partial excision of the sac there can be little doubt that this must be extremely rare since after efficient removal of the parietal layer of the tunica vaginalis the cavity must with very few exceptions be entirely obliterated.

The cases to which this method appears to me to be especially suitable are those (a) Where tapping or injection has failed (b) Where the sac is very large or has very thick walls (c) Where the patient is young and healthy and a radical cure is desirable and especially where radical cure is demanded before the patient can enter one of the public services (d) Where the surgeon is desirous of exploring the sac of the tunica vaginalis as in cases where enlargement of the testis of a doubtful nature co-exists with hydrocele and does not yield to ordinary treatment where a hæmatocele has supervened on a hydrocele or in the much rarer cases of loose bodies in the sac of the tunica vaginalis (e) Where several hydroceles co-exist e.g. either double hydrocele of the tunica vaginalis or a vaginal and encysted hydrocele (f) In certain cases of hydrocele complicated with hernia e.g. (1) in young subjects where a radical cure

of both is desired ; (2) in much older patients, where the hernia is irreducible. where, especially in unhealthy patients, there is a risk of the inflammation set up by the injection extending to the sac of the hernia. (g) In cases of congenital hydrocele an operation is usually desirable when spontaneous cure does not take place ; a truss fails to obliterate the communication with the peritoneal cavity. (h) The same course will be wise in the case of encysted hydroceles of the cord.

Operation. While an assistant pushes the hydrocele up towards the groin an incision three inches long is made over the corresponding external

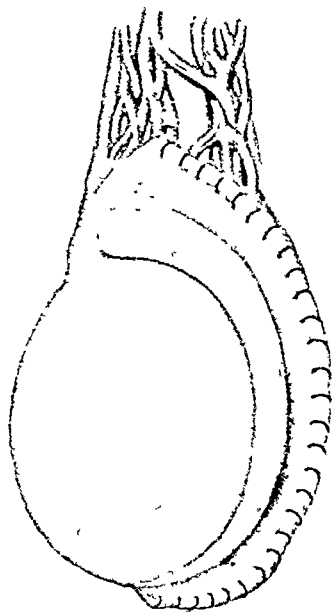


FIG. 404. Excision of parietal part of tunica vaginalis. The cut edge often bleeds freely and to control this a continuous catgut suture is inserted. The edge is really quite close to the epididymis.

ring and the upper part of the cord. The divided external pudic vessels are secured and tied. The coverings of the tunica vaginalis are incised until the latter, which is very mobile within its coverings, projects into the wound. It is opened, and as the liquid escapes the edges of the opening are cleanly picked up with forceps. When these are accurately held without any of the coverings, the parietal layer of the tunica vaginalis can be very rapidly and easily separated from its coverings by gauze dissection without appreciable hæmorrhage. The separation is carried close up to the epididymis on the outer, and to the back of the testicle on the inner, side. Along these limits it is snipped away with curved scissors, and forceps are applied to all bleeding-points which are tied or sewn over with catgut in order to arrest all hæmorrhage. No flaps of tunica vaginalis are left for future pocketing. During the separation the testis is drawn out of the wound. The epididymis is examined carefully for cysts, which are not uncommon about the globus major. If any of these, or hydatids of morgagni, are found they should be removed and all bleeding arrested. The

testicle is replaced in the scrotum, care being taken to avoid rotation of the cord. The wound is closed with fine catgut sutures, slightly evert-ing the edges. These do not need removal—a difficult and painful ordeal when unabsorbable sutures were used.

In cases where the origin is doubtful or where the hydrocele is large and of long standing and the testicle wasted, it is wise to obtain permission beforehand to remove the testis.

As a rule it is wise to leave a temporary drain in the lower part of the wound, for otherwise a hæmatoma may follow the removal of a large hydrocele. Recurrences after this method are very rare. Aseptic dressings are secured in place by firm and even bandaging or by a large suspender so that the scrotum is kept well up.

Hydroceles of the canal of Nuck and encysted hydroceles of the cord

are best excised if they give rise to pain or inconvenience. Encysted hydroceles of the epididymus rarely attain a size large enough to cause much trouble. When they do they may be excised, care being taken to remove the whole sac. Operation is rarely necessary for the multiple small cysts that form in some elderly men as a degenerative change. This condition is usually bilateral, it sometimes causes pain, especially upon riding a horse or bicycle. Under these circumstances one epididymus may be excised with good results, when both are affected and sterility does not matter they may be removed with advantage.

II Eversion of the Tunica Vaginalis (Jaboulay) Under local or general anaesthesia, the tunica vaginalis is exposed anteriorly and incised sufficiently to allow the testicle to be brought out. Traction is made upon this organ while the scrotum is held. Thus the tunica vaginalis becomes completely everted so that its serous surfaces face outwards. It is secured in this position by means of two or three catgut sutures which are passed near the edges, which are now posterior and surround the spermatic cord. Care must be taken that the stitches do not compress or injure the cord. Sutures are not always necessary when the opening into the tunica vaginalis is made only just large enough to allow the testicle to be prolapsed. The testicle is then replaced in the scrotum and the wound closed. The endothelial surface of the serous sac now faces the scrotal fibrous and areolar tissues, to which it generally becomes adherent in a short time, and any temporary serous effusion is drained away by the lymphatics of the scrotal coverings.

At first it was considered to be necessary to shell the unopened tunica vaginalis and the testicle out of the scrotal coverings in order to obtain proper eversion, but this step is superfluous and is attended with troublesome hæmorrhage.

This ingenious and simple operation is not so successful as might be imagined, for recurrence has followed it and the cord has been seriously compressed. Longuet records twenty two cases without recurrence, and Dudley Tait¹ records three cases. It is not stated how long these patients were observed. The operation has not found much favour in England, because excision of the parietal part of the tunica vaginalis is a more certain radical procedure.

III Injection of Carbolic Acid This method was introduced in 1881 by Dr Lewis of Philadelphia.² The following advantages have been claimed, and are my opinion largely substantiated. (a) It is less painful than iodine. (b) It is more certain, curing about 75 per cent, but sometimes the injection has to be repeated. (c) There is less risk of sloughing. (d) The patient is only kept from his employment for a day or two or not at all.

Complications (1) Reaction. Cellulitis and Suppuration. It is right to say that in some of the cases in which these have followed on the injection of carbolic acid an excessive quantity seems to have been employed. Thus Dr R. Abbe³ reports that he injected three drachms of carbolic acid and glycerine into a large hydrocele sac, and that acute suppuration followed, requiring incision which cured the hydrocele. He

¹ *Ann of Surg*, 1901 xxxiii 305.

² *Boston Med and Surg Journ*, 1881 cv 540.

³ *New York Med Journ*, December 22, 1883.

allows that the above quantity is excessive, one drachm always sufficing. Dr. R. F. Weir,¹ in one case in which the iodine treatment had failed, injected three drachms of carbolic acid : this was followed by the usual absence of pain, but with recurrence of the swelling in a few days, which went on to suppuration and, after incision of the sac, shreds and large masses of membrane were discharged, gangrene of nearly the entire tunica vaginalis being produced.

(2) Carbolic Acid Poisoning. Most writers have distinctly stated that this does not occur. It is certainly extremely rare, as it is probable the surfaces are sealed by the carbolic acid ; but Dr. J. Murphy, at a discussion at the New York Association,² said he had known of three or four cases in which carbolic acid used in this way was followed by bad effects, especially on the kidneys. He had seen one case terminate fatally, and he could not attribute this death to anything but carbolic acid poisoning. He did not know how much carbolic acid was used. I know of one case of death from pulmonary embolism a few days after injection of carbolic acid. Hæmorrhage into the sac may also occur.

My own experience is too limited to be of any value. I have used partial excision of the sac, and have been so well satisfied with it as to prefer to use it wherever the patient can lie up. There is no need of Levis's special instrument. What is essential is to use liquor carbol. liquefact. and not to inject more than one drachm, and to lodge it well within the tunica vaginalis. This may be done by means of an exploring syringe with a fine needle. The needle attached to the syringe is first lodged safely in the cavity of the hydrocele, which is then tapped in the ordinary way with a fine hydrocele-trocar. When the sac has been thoroughly emptied the cannula is withdrawn, and the syringe containing the solution must be fitted on to the needle, which has been kept *in situ*, and the solution injected. However this is done, the carbolic acid must be brought in complete contact with the interior of the sac by manipulating the scrotum, which is then supported by a suspender.

VARICOCELE

Indications. While palliative treatment will be sufficient in the great majority of cases, if, at the same time, due attention is paid to the general health, the occupation and habits of the patient and, where this is required, to his sexual hygiene, an **operation** will be **justifiable** in the following cases :

(1) Where the patient is precluded from entering one of the public services, or any occupation involving much activity in the upright position. (2) In any case where the varicocele persists or steadily increases in spite of treatment, and where it is accompanied with much distress, annoyance or pain, or where it interferes with some justifiable pursuit, such as riding ; (3) where the patient is going to reside in a hot climate, where a small varicocele soon enlarges from want of support from the atonic cremaster and dartos. Where the patient is clearly a hypochondriac or a monomaniac in genital matters, no operation is, of course, to be thought of. It is certain to be a failure.

¹ *Boston Med. and Surg. Journ.*, 1881, cv, 540.

² *New York Med. Record*, June 20, 1891.

The choice of operation is a very large one, but as I consider that one alone has been proved to be alike efficient and simple, I shall not occupy my space with an account of any others or with the history of the operation. Like so much else in operative surgery, the only efficient and simple operation for varicocele dates to the great discovery of Lord Lister¹.

Excision. This operation performed with the parts well in sight, has the very great advantage of allowing the surgeon to carry out each step with precision to include what he thinks safe and no more while Lord Lister's teaching has enabled us to perform it without the risks of

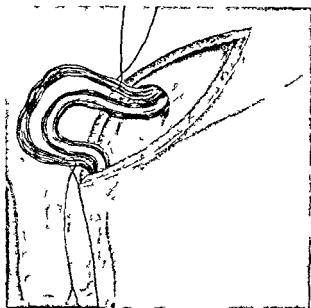


FIG. 40b. Operation for varicocele. Incision in the groin over the external ring. Some veins are left in front as well as some behind the vas deferens.

hæmorrhage cellulitis and blood poisoning which were so terribly frequent in operations on veins performed before his day.

Whereas a general anæsthetic is usually better for both patient and surgeon local analgesia is satisfactory novocaine (0.75 per cent) being injected to anæsthetise the skin and when the cord is exposed, some of the solution is injected before opening its sheath which becomes distended. The patient or part, having been anæsthetised and the field of operation isolated with aseptic towels, the assistant makes the veins prominent by grasping the cord with finger and thumb just below the external abdominal ring thus protruding the varicocele. The skin incision, which should be about an inch and a half long is made above the scrotum and in front, over the external abdominal ring. If this plan is adopted it will be found that the cord is quite easily pushed up into the wound, and it has the advantage of rendering the operation more con-

¹ Sir Henry Howse drew attention to the method of aseptic excision in varicocele (*Guy's Hosp. Repts.*, 1887 xxiii 408).

venient, whilst the wound is more easily dressed and heals more certainly and readily than one which involves the skin of the scrotum. Further, the spermatic veins are less numerous, and more easily separated from the vas than lower down, and the tunica vaginalis is very unlikely to be opened.

The sheath of the cord is opened and the packet of veins is exposed and is then carefully opened. The veins are gently separated into two bundles, leaving only one or two veins in front of the vas. This gap is enlarged, and the anterior bundle of veins is separated by gauze dissection from the external ring to the testicle. The bundle is tied with fine catgut near these two points, care being taken to avoid the coil of the vas in placing the lower ligature. One end of each ligature is left long, and these ends are tied together so as to bring the two stumps together. The object of this important step is to shorten the cord permanently and to restore the natural suspension of the testicle. All bleeding vessels are tied and the cord is replaced. Another step should be taken before the close of the operation, *i.e.* ligature and removal of any very enlarged scrotal veins, a step which I always adopt when the patient's attention has dwelt on these. Some surgeons also remove redundant scrotal skin, so that the remainder may support the testicle. The whole wound, superficial and deep, is then carefully scrutinised and, every bleeding-point being secured, is thoroughly dried. The edges of the wound are then carefully adjusted with a continuous suture of fine catgut.

Aseptic dressings are then applied and kept on by means of a suitable suspender, which also keeps the testicle up, thus easing pain and preventing swelling of the testicle. The patient is allowed up a little more every day, after the third, but he wears a suspender for several weeks with great advantage and comfort.

The points to which I attach most importance in the operation are maintenance of strict asepsis throughout, the careful selection of the number of veins to be removed, suturing together the two stumps and so shortening the cord and providing for suspension of the testicle, arrest of all hæmorrhage, and thorough drying of the wound. I look upon these details as most necessary if rapid healing is to be made certain, and epididymo-orchitis and hydrocele prevented. It is not safe to remove all the veins in front of the vas, for this may lead to epididymo-orchitis, hydrocele of the tunica vaginalis or even atrophy of the testicle from interference with the blood, lymphatic and nerve-supply of the testicle.

The chief risks and causes of failure in the operation are as follows :

I. **Sepsis and its results.** The operation, although it may appear to be trivial, is not one to be undertaken lightly, and it should not be performed except under aseptic conditions, lest cellulitis, septic thrombosis or even sloughing of the testis occur. Short of these catastrophes, supuration around the ligature may occur unless catgut is used instead of silk, and the precautions already mentioned are observed. A troublesome stitch sinus results, and frequently a hydrocele of the tunica vaginalis develops in such cases.

II. **Inclusion of too many veins.** That this is a real danger is shown by a case which Mr. Jacobson published.¹

III. **Atrophy of the testis.** This may occur from destruction or

¹ *Syst. of Surg.*, iii, 571.

injury of the sympathetic nerves of the testis which run with the vas. In order to avoid this rare sequel care must be taken to leave the vas well alone it is not necessary to touch it.

IV Division or Laceration of the Vas Deferens This has happened to careless operators more commonly than would be suspected from publications. Atrophy of the testis does not occur if the injury is limited to the vas deferens. The accident is most likely to happen from want of care in separating the lower coiled part of the duct from amongst the bulky mass of veins near the epididymis.

V Recurrence of the Varicocele I am of opinion that if operation cases were more thoroughly followed up afterwards this sequel would be found to be more common than is thought to be the case. To prevent this risk of recurrence Sir Wm. Bennett lays stress on the need of removing the entire plexus of spermatic veins. As I have been unfortunate enough to meet with a case in which in spite of care taken too many veins were ligatured and removed I cannot agree with Sir Wm. Bennett. Another instance of what appears to be recurrence but which is really an escape of the upper part of the spermatic plexus may be due to the upper ligature being applied too low down (Bennett). In this case the part of the plexus between the upper ligature and the external ring remains full and may give trouble for a time though it gradually shrinks.

Corner and Nitch¹ have shown that the results were not very satisfactory in a series of 100 operations. Twenty three of these patients still complained of pain 23 had hydroceles and either fibrosis or atrophy of the testis had followed in many cases.

EPIDIDYMO VASOSTOMY

Bilateral gonorrhœal epididymitis is by far the commonest cause of sterility in men. the globus minor or the lower part of the vas deferens becomes obstructed. The best way of overcoming this is by anastomosing the vas to a healthy globus major. The following description of the operation of epididymo vasostomy is that of Dr. Francis R. Hagner.²

Technic In our earlier cases we followed the technic devised by Martin but of later years we have felt it was better to open the tunica vaginalis exposing the entire epididymis as from this approach we are better able on inspection to pick out the portion of the globus major richest in tubules thereby facilitating the discovery of the portion that may contain live spermatozoa. On opening the vas we used to inject argyrol to be sure that the vas was patulous. We have discontinued this technic as we feel it is important to keep all foreign substances that may tend to cause cicatrization away from the field of operation. We now use the finest tear duct probe to be sure we are in the lumen following this with a smooth strand of silkworm gut which can in the unobstructed vas be passed from 16 to 20 cm. When we have done this we feel reasonably sure that the vas is patulous. If it is obstructed beyond this point there is no hope of an operative cure. After this examination has been made we pick out a likely looking place in the

¹ *Brit. Med. Journ.* 1906 i 191

² *Young's Practice of Urology* 1906 i 541

epididymis, cutting out an elliptical piece (Fig. 406). If live spermatozoa are present, a milky fluid is usually obtained as soon as the section is removed. The fluid is at once examined on a warm slide, the presence and motility of the spermatozoa being noted. If no spermatozoa are found, this incision is closed with a catgut suture; another place is selected and the same procedure is followed.

"We have tried several types of sutures, very fine silkworm gut and very fine silver wire. Our only successful cases are those in which we used the silver wire. We cannot explain this, unless there is less tissue reaction with silver wire than with the other sutures.

"Nearly all our operations have been done by lateral anastomosis, except a few rather atypical cases to be mentioned later. Sometimes we

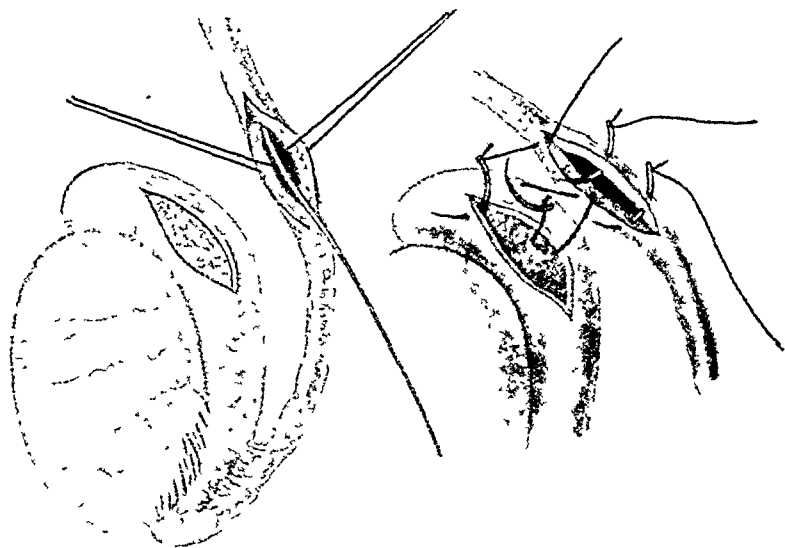


FIG. 406. Epididymovasostomy (after F. R. Hagner). A fine silkworm gut suture is inserted in the vas, and the latter is joined to the epididymis by silver wire sutures, which are so placed as to bring some tubules of the epididymis into the lumen of the vas.

find occlusion of the vas at the first incision, and by going further up the vas we are able to get above this obstruction. Care is exercised to cut only into the lumen of the vas, as it is very easy in making this incision to cut through the entire diameter of the tube.

"We place the first suture at the distal end of the incision in the vas, taking a good heavy bite, as this is the anchoring suture for the operation and the obstruction is beyond this point. It is then anchored firmly in the lower end of the elliptical incision in the epididymis. Two lateral sutures are then placed to take a fairly heavy bite and include some of the cut tubules (if only the fibrous covering of the epididymis is taken up the cut tubules drop back when the anastomosis is made). The suture is then passed through the cut edges of the vas, taking just enough tissue to approximate the edges. The last suture is then passed in the same way through the upper end of the incision in the vas, being

carefully placed so as not to occlude the lumen (Fig 406) The anastomosis is then complete "

Results In 21 cases in which the results were known there were 8 cures (38 per cent)

ANASTOMOSIS OF THE VAS DEFERENS

A divided vas deferens may be anastomosed by slitting the distal cut end for about an inch, so that two flaps are formed by two incisions, one on each side of the vas One of these incisions is then carried up a little further (half an inch), and the obliquely pared testicular end of the duct is then laid in contact with the lumen of the urethral part and secured with very fine catgut sutures The equal tails of the urethral end are then wrapped round the testicular part of the vas and sutured in position Layers of fascia are then wrapped round the anastomosis and fixed in position by sutures ¹

Lydston ² passes a thread of silkworm gut into both ends of the vas and brings one end of the thread out through the side of the proximal part of the tube, and later through the skin The ends of the vas are brought together by two catgut sutures, and the anastomosis is reinforced by folding the ' sheath of the cord ' around the vas and securing it in apposition by means of a continuous catgut suture The silkworm gut thread is removed after ten days

The vas has also been anastomosed to the rete testis or to the globus major to overcome obstruction at the globus minor

Ligation of the Vas Deferens (Steinach's Operation). K M Walker and J A L Cooke ³ discuss this operation and report four cases They do not think there is at present sufficient evidence that the operation attains its object Steinach claims that by checking spermatogenesis it increases the internal secretion of the gland, causing rejuvenation in cases of premature senility

The vas is sometimes tied with the object of preventing epididymo orchitis from ascending infection from the urethra, especially as a complication of enucleation of the prostate, but it does not always succeed

ORCHIDECTOMY *

Indications Malignant Growths of the Testicle

Diagnosis of Malignant Disease of the Testis. As the records of surgery contain many instances of mistakes under able hands—hæmatoceles removed for malignant disease and malignant disease opened for hæmatoceles—a few hints may not be out of place here on this subject

The following are the points on which most reliance may be placed

Continuous, and often quickly progressing, solid enlargement of the testicle or epididymis without inflammation Sometimes this progress is much slower, occasionally it may seem to be in abeyance, but careful watching with frequent examinations (and these are the key to obscure

¹ Lynn Thomas, *Brit Med Journ*, 1904, i 13

² *Ann of Surg*, 1906 xliv, 92

³ *Lancet*, 1924, i, 223

* Castration or double orchidectomy is to be avoided, whenever possible, for obvious reasons

cases) will show that the enlargement is progressing in spite of treatment. Failure of well-directed treatment. Where the swelling is small, still oval in shape and smooth and firm in outline, the Wassermann reaction should be tried. *Consistence.* This is rarely for long the same all over the swelling. Even if firm, slow growth seem uniform and recall orchitis, a careful examination will usually find one or two spots which are more *elastic* than the rest. Usually the softening at places where cystic or degenerative changes are taking place is well marked. But it may require somewhat prolonged watching to detect one or two, at first, lowly rising projections or bosses which foretell that the tunica albuginea is becoming thinned at this spot. Of enlargement of the cord, fulness of the scrotal veins, adhesion of the scrotal tunics, increasing aches and pains, I say nothing, as they are evidence that the disease is entering into a later stage.

An exploratory incision is to be preferred to the use of a trocar, as being more certain to give information. A trocar may enter a solid part or withdraw some scanty mucoid fluid. Sometimes the amount of blood which flows through the cannula of a trocar thrust into a testicle, the subject of rapidly growing malignant disease, is so great as to lead to the supposition that it must be a hæmatocele. In such cases, however, the diminution of the swelling is not so proportionate to the flow of blood as it would be in hæmatocele. Furthermore, the blood is usually bright, not dark and altered, as in hæmatocele. Early operation is strongly indicated in these cases.

Contra-indications. Orchidectomy should not be performed nor the extensive radical operation attempted when the lumbar or iliac glands are enlarged, as shown by palpation or signs of pressure upon veins or viscera. The knees must be well flexed and the abdominal muscles relaxed to enable us to feel early enlargement of the lumbar glands.

Similarly, extensive local spread along the cord in the inguinal canal extending into the iliac fossa is a contra-indication and, above all, any evidence of secondary growths anywhere in the body. In some cases, however, the removal of a large primary growth, threatening to fungate and bleed, is a humane act, although it may not materially prolong life.

Prognosis. It will be seen that the prognosis is always grave, extremely so in the softer and more rapid growths. Kocher goes so far as to say with regard to these that no case of really permanent cure of encephaloid carcinoma is known. In medullary teratomata, especially in children, the prognosis is almost as gloomy. But while the above opinion is only too true of the majority of cases, a sufficient number have been recorded to show the benefit which may follow on orchidectomy, even in the soft form of sarcomata. Kober collected 105 cases of sarcoma of the testis, out of which 9 were known to be free from recurrence over three years after the operation.

Chevassu collected 100 cases of orchidectomy for malignant disease of the testicle; of these only 19 survived over four years.

In the museum of St. George's Hospital is a specimen of a testicle converted into a mass of soft malignant growth, with large caseating patches, which Mr. Caesar Hawkins removed from a patient aged 45, the enlargement having lasted two years. Twelve years later this patient was alive, and in good health. In the *Med. Times and Gazette*, 1886, ii, 287, a case of Mr. Cock is mentioned in which a patient remained

in good health for six years after orchidectomy for testicular cancer being then lost sight of in consequence of his emigration to Australia

The late Sir Henry Morris¹ related two remarkable cases of carcinoma of the testis with prolonged freedom from recurrence after simple orchidectomy. One of these lived nine years and then died of secondary growth in the loin invading the spine and causing intestinal obstruction. The other patient was well twelve years after operation.

While these cases are encouraging I fear they are exceptional.

As a rule the retroperitoneal glands and viscera will be involved by extension and secondary deposits within six months of the time of orchidectomy. And this result is the more disappointing because the testicle is a free floating organ and one placed independently in a fibrous capsule appears to be remarkably favourably placed for the removal of malignant disease. The intimate association of the organ with the lymphatic system both within itself and with those in the abdomen and the facility with which these are very soon implicated handicap us terribly here. But if as happens most frequently the disease recurs elsewhere after orchidectomy a useful life may yet be prolonged the patient rid of a wearisome encumbrance is made more comfortable and towards the close death from internal deposits of malignant disease is not accompanied with the same distress both to the patient and those around him as when the disease is situated externally. In proof of the temporary benefit of orchidectomy Mr Curling² relates the case of an eminent barrister who for two years and a half after the removal of a testicle for soft cancer was able to continue the practice of his profession to the great advantage of his family death ultimately taking place from extension to the lumbar glands. It is probable that earlier operation with the removal of the lymphatic vessels and glands in the loin will be attended with more success (p. 739).

II Tubercular Testicle The treatment of seminal tuberculosis is fully discussed later (p. 743). When the body of only one testis is involved orchidectomy is necessary but when the disease is bilateral or affecting the only remaining testis it is advisable to save any part of the testicle that is healthy because of the importance of its internal secretions.

III Syphilitic Testis Here owing to the specifics which we possess operation is much more rarely called for but when suppuration has taken place and does not rapidly clear up under medicinal treatment orchidectomy hastens recovery and return to work.

IV Old Haematocele

Indications Failure of previous treatment especially in a man of middle life whose activity e.g. in riding is much interfered with.

The frequency with which malignant disease follows on repeated injury and irritation of the testicle is well known.³

V Retained Testis

Indications (1) When such a testis is the seat of malignant disease (2) When it seriously cripples the patient by the recurrent attacks of pain and inflammation associated with it (3) When the testis gets twisted or strangulated and necrotic as the result of a long meso testis which com-

¹ *Lancet* 1910 i 634

² *Diseases of the Testis* p. 34

³ *Rudolf's Path. Hist.* ii 197

monly exists in these cases. (4) When a co-existing hernia cannot be kept up by a truss owing to the presence of the testis, a radical cure of the hernia should be undertaken and, if the patient be well over puberty, the testis should be removed, for it is very unlikely to be functional, and therefore it is not worth attempting to place and keep it in the scrotum. In a child under these circumstances it is sometimes important to save the organ and perform orchidopexy, as well as a radical cure of the hernia.

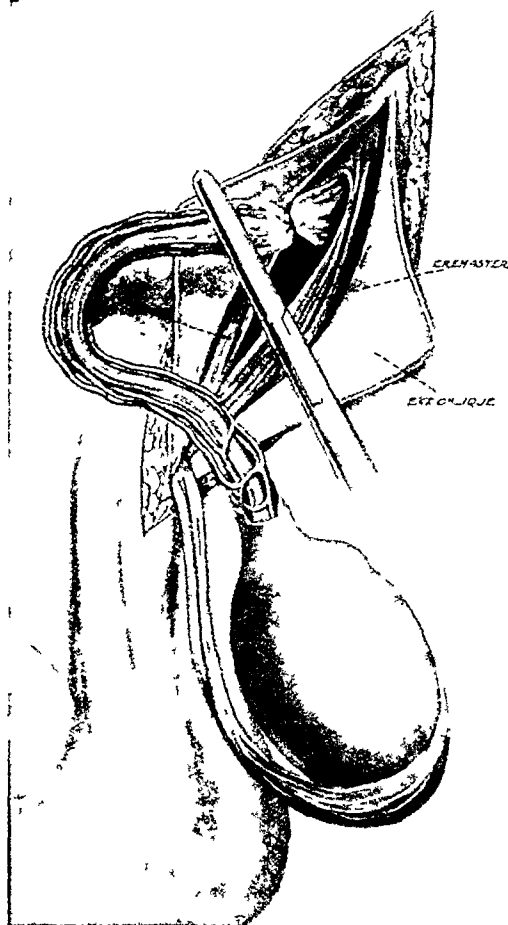


FIG. 407 Orchidectomy. The inguinal canal is opened and the cord separated up to the internal ring or even higher. It is crushed and tied with catgut.

Operation. The surgeon protrudes the testicle with his left hand so as to make the overlying tissues tense, and divides these from an inch above the external abdominal ring, prolonging his incision as required.¹ In cases where the skin is involved by a growth, ulcerated by a hernia testis or invaded by tubercle, two elliptical incisions should be made, well wide of the disease, and meeting above and below. The first incision

¹ Kocher makes a transverse incision across the lower pole of the testis in septic cases and large tumours. The incision is parallel to most of the large scrotal vessels and little bleeding occurs, and, above all, the drainage is excellent.

having exposed the cord above, this is hooked up and isolated as high as may be needful, the inguinal canal being opened, if this is necessary to get above the disease. The cord is then clamped with two strong artery forceps, tied with strong catgut and divided, but not too near to the ligatures, which may otherwise slip. There is no need to transfix it, it is simpler and better to tie it in the groove left by the clamp. Usually one ligature suffices, but several may be needed when the cord is bulky. If no bleeding occurs the ends of the ligature are cut short, and the cord is allowed to recede out of sight. When there are sinuses or abscesses in the scrotum, the cord is isolated, ligatured and divided before the incision is carried down into the infective tissues of the scrotum. The clamp on the lower end of the cord serves as an excellent tractor during the separation of the testicle and its coverings from the scrotum.¹

The wound is then examined in the case of a soft, rapid growth and, where a tubercular testis has threatened to fungate, any suspicious skin must be excised. A few scrotal vessels notably one in the septum, may require tying. The wound is then closed pains being taken to meet the tendency of the scrotal edges to invert. A tube is left in the lower part of the wound for thirty six hours.

In clean cases and those with only moderate enlargement, I think very highly of Kocher's incision, which is made over the lower part of the inguinal canal and the external abdominal ring just below which the intercolumnar and the cremasteric fasciæ are divided and the cord is exposed high up, ligatured and divided as described above. The canal must be opened in tuberculous cases and most of the abdominal part of the vas is to be removed. The testicle is then shelled out all hæmorrhage stopped the wound completely sewn up, and the dressings applied firmly to prevent any oozing. The advantages of Kocher's incision have been enumerated at p. 731.

Radical Operation for Malignant Disease of the Testicle. As already pointed out on p. 736 the limited operation of orchidectomy described above when adopted for malignant disease, has not been attended by great success. The majority of growths of the testicle are malignant or potentially malignant, and sooner or later infect the lymphatics and the lumbar glands. It is true that G. W. Nicholson² did not find sarcoma invading the lumbar glands, but this growth is very rare. For the great majority of growths of the testicle, it is wise to remove the draining lymphatics and lymphatic glands at the primary operation. Morris³ as long ago as 1895 removed with great difficulty a mass of secondary glands in the loin two years after orchidectomy for carcinoma, and the patient survived for nine years, but ultimately died of secondary growth invading the spine and causing intestinal obstruction. Roberts⁴ performed a similar operation, but the patient died. When the lumbar glands are palpably enlarged an attempt to remove them is inadvisable, for the disease will have spread to the secondary glands higher up, which are irremovable. Our endeavour should be to operate early and to remove the lymphatics and glands in one piece with the testicle. Sir John Bland

¹ There is often an adhesion below between the testis and the fundus of the scrotum (Fig. 407). This represents according to some the remains of the mesorchium.

² *Guy's Hosp. Reps.* 1907 lx. 249.

³ *Lancet*, 1912, i. 634.

⁴ *Ann. of Surg.*, 1907 xxxvi. 539.

Sutton¹ describes such an operation in detail with an interesting case. The patient, although he developed a secondary growth in the neck six months later, was well two years afterwards.

The following remarks are taken from a valuable paper by Mr. Morriston Davies.²

“Very slowly has it dawned upon surgeons that malignant growths of the testicle should be treated in the same rational manner as malignant disease of the tongue or breast—so slowly, in fact, that since Grégoire did the first complete radical operation in 1905 only 12 cases treated in this manner have been recorded. At the present time every surgeon recognises the imperative necessity of removing the glands and lymphatics (with the surrounding fascia) which drain an area, such as the tongue or breast, the seat of a malignant growth; and the enucleation of the infected glands in such cases is regarded in almost the same light as attempting no gland operation whatever ‘because there is no clinical evidence of involvement.’ There is no reason why the same radical treatment should not be adopted in cases of malignant disease of the testicle; that the glands are at a distance from the primary growth and need a much greater amount of care and trouble to remove is no contra-indication whatsoever. It is quite feasible (and the danger of the operation is incomparably small compared with that of recurrence when the testicle only is removed) to take away the testicle, cord, the artery and veins of the vas up to their origin from the aorta and entry into the vena cava or renal vein, the lymphatics draining the testicle, the glands into which they drain, and the surrounding fascia in one piece. The heavy mortality from recurrence in cases of simple castration, the proportionate frequency with which glands that could not be felt clinically and apparently normal macroscopically have been found on microscopic examination to be invaded by growth, should be sufficient to make the radical operation the routine procedure.

“Before giving details of the operation a fuller understanding of the lymphatics of the testicle is necessary. Numerous experiments have been made by the injection of coloured fluids and dissections by Jamieson and Dobson, Most, and Cunéo. These researches have shown that the glands which are in direct communication with the testicle lie on either side, over, and between, the inferior vena cava and the aorta, usually between the level of the bifurcation of the aorta below and the renal veins above, but that occasionally a gland may be found as low as the bifurcation of the common iliac, and as high as just above the renal veins. From this group of glands lymphatics pass out laterally, upwards and downwards to other glands, the uppermost of which are in close relation to the receptaculum chyli. From clinical evidence (and the ease with which injected substances pass through the primary into the secondary group of glands) it seems that the secondary outlying groups may be infected soon after the primary ones have become diseased. Certain it is that when once the glands have become palpable dissemination of the disease progresses rapidly.

“The secondary glands lie so high up in the abdomen and are so covered by the duodenum, pancreas, &c., that they are very difficult of

¹ *Lancet*, 1909, ii, 1406.

² *Ibid.*, 1912, i, 419.

access. So long as the diagnosis of growth of the testicle is made fairly early and the radical operation is undertaken before the primary group of glands is extensively implicated it is sufficient if these only are removed. The lymphatics of the primary group connected with the right testicle lie to the outer side and over the vena cava between it and the aorta and



FIG 408 Radical operation for malignant disease of the testicle. The draining lymphatic vessels and lymph glands are removed with the primary growth in the testis. (Modified from Chevassu.)

over the right half of the aorta while those connected with the left testicle have no relation to the vena cava but lie over and on the left side of the aorta. The glands have been removed by the intraperitoneal and the extraperitoneal routes the latter is undoubtedly preferable.

The Radical Operation The incision which has been most often employed to allow of removal of the testicle and cord and to give access to the lumbar glands commences over the upper part of the scrotum

extends up to the external ring, along the inguinal canal, and is prolonged to a point half an inch above the anterior superior spine; the incision then curves upwards till it reaches the costal margin at the level of the tenth rib. At the beginning only the first part of the incision to the external ring is made and the testicle and cord are dissected free. If there is any doubt as to the diagnosis the testicle should be incised at this stage. If malignant disease is present the operation is continued. The incision is prolonged in the direction defined above and carried through the muscles of the abdominal wall until the peritoneum is reached. The cord is traced till it passes through the internal abdominal ring, and then while the sides of the incision are strongly retracted slight tension is applied to the cord so that its further course may be easily recognised. In its retro-peritoneal course the vas is adherent to the posterior aspect of the peritoneum and the next stage in the operation consists in freeing the cord and reflecting the peritoneum mesially. The vas is traced down well into the true pelvis and there divided between two ligatures, the cut surfaces being treated with the cautery or pure carbolic. This may be regarded as the first stage in the operation and requires no extraordinary care. The second stage consists in the free dissection of the fascia over part of the iliacus and psoas muscles together with the contained spermatic vessels and lymphatics and the removal of the glands from off the inferior vena cava and aorta (*see* Fig. 408).

"When the vas has been divided the spermatic vessels are seen no longer to form a rounded bundle but to become spread out. It is therefore necessary to make a wide dissection of the fascia. On the outer side this should extend to the outer border of the psoas. On the inner side the line of division of the fascia should pass mesially so as to cross the common iliac at its bifurcation; the ureter will here be encountered and must be freely exposed. The dissection is then carried along the inner side of the common iliac vessels up to the bifurcation of the aorta. When the left testicle is affected the inner boundary is carried up along the right border of the aorta, and special care must be taken not to injure the inferior mesenteric artery. When the right testicle is the seat of the tumour the inner border is continued over the middle of the aorta. In both cases the upper limit is the upper border of the renal veins. Between these boundaries all fascia, lymphatics and glands must be removed. During the dissection the spermatic vessels are traced up to their junction with the main vessels and must be ligatured and divided. When all bleeding-points have been secured the peritoneum is allowed to return into position and the abdominal wound is closed without drainage, each of the muscles being stitched up separately."

I prefer to drain the large deep wound for thirty-six hours, and to adopt Bland-Sutton's vertical incision through the lineal semilunaris. This gives a more direct access to the lymphatic area and, moreover, it is easier to close the abdomen satisfactorily. Hinman, Gibson and Kutzmann¹ have analysed the results of the "radical" operation in 79 cases of teratoma of the testis. Nine of these had palpably enlarged lumbar glands before the operation and all died soon afterwards. They estimate that 30 per cent. of "cures" followed the operation with an immediate risk of 12.6 per cent. mortality. On the other hand, simple orchidectomy

¹ *Surg., Gynec. and Obst.*, 1923, xxxvii, 429.

offers only a 15 per cent chance of cure. It is however too soon to judge whether the results of the radical operation are so much better as to justify its much higher mortality. Every case must be considered upon its merits. In some cases it is an undoubted advantage to remove the testis first and to submit it to a reliable pathologist. If necessary the lymphatics and glands can be removed later at a smaller risk of death from shock.

EPIDIDYMECTOMY

Indications (1) *Certain cases of tuberculosis of the testicle*. There are still differences of opinion as to the relative value of epididymectomy and orchidectomy for this disease. The relative advantages of the two operations should be considered in every case for these depend on the extent of the disease and the condition of the patient. Barney¹ in an analysis of 153 cases many of which were treated by epididymectomy found no local recurrence in any case after this operation. Therefore as regards local recurrence epididymectomy seems to be as satisfactory as orchidectomy. As regards infection of other parts of the genito-urinary organs especially the opposite epididymis Barney found that this was just as likely to follow orchidectomy as epididymectomy. This is not very surprising seeing that on admission 50 per cent of the cases had similar disease of the prostate or vesiculæ and 30 per cent had disease of both epididymis. H. H. Young² maintains that the disease is primary in the vesiculæ in all cases. It is clear that epididymectomy is indicated under the following circumstances:

(a) All cases of tuberculous disease of a solitary or remaining testicle unless the body of the testes is seriously affected for it is important to preserve the latter or even a well nourished portion of it for its internal secretion in order to prevent melancholia and preserve the male characteristics.

(b) When the disease is bilateral orchidectomy may be done on the worse side and epididymectomy on the other.

(c) For early unilateral disease localised to the epididymis epididymectomy may be performed but the body of the testes should be examined to see if there is any evidence of disease invading its posterior part.

(2) *Certain cases of extensive cystic disease of the epididymis in elderly men*. These cysts sometimes cause much pain and swelling or induce vaginal hydrocele.

Operation When there is no adhesion to the skin or sinus a Kocher incision is made over the external ring and the testicle is displaced upwards and out of this wound but an elliptical incision is made around any adhesion or sinus which are generally located at the postero-lateral and inferior part of the scrotum. The tunica vaginalis is freely opened and examined. Occasionally it is tuberculous then orchidectomy must be performed. The testicle and epididymis are examined. If the former seems healthy the reflections of the serous membrane extending from it to the epididymis are incised and the globus minor is separated from below upwards. As the globus major is approached care must be taken to preserve the blood supply of the testis which enters the latter near the

¹ *Boston Med. and Surg. Journ.* 1911 : 913 and *ibid.* 1917 : 409

² *Practice of Urology* 1908 : 515

upper part of the globus major and on the inner aspect of the latter. The attachments of the globus major are divided and any bleeding vessels are tied. Then an incision is carried forwards through the meso-testes into the body for about half an inch, and if the testis is healthy the wound is closed with catgut and all bleeding-points are stopped by suture. Then the vas deferens is followed up and removed together with the loose connective tissues around it. Generally it is sufficient to remove as much as can be drawn down through the external ring, but if there is any evidence of disease higher up the inguinal canal must be freely opened, and as much of the vas removed as possible.

RADICAL OPERATION FOR TUBERCULOSIS OF THE SEMINAL TRACT

It is important to remember that tuberculosis of the seminal tract is rarely primary, but secondary to tuberculosis of some other part of the body, often in the peribronchial or retroperitoneal glands or in the lung. It is also essential to realise that seminal tuberculosis generally begins in the pelvis, in or about the vesiculæ seminales, whence it may travel along the lymphatics or along the vas deferens to the epididymis, or along the lymphatics and ducts into the prostate, urethra or bladder; it may also travel along the lymphatics upwards into the kidney.

These facts explain the unsatisfactory results of limited operations for tuberculosis of the epididymis, and the apparent recurrence or real persistence of the disease in other parts of the seminal or genito-urinary tracts.

Ullman removed the seminal vesicles through the perineum as long ago as 1889. The same operation was carried out by Weir in 1895, through the groin, and by Bolton, through the sacrum, in 1899. In 1900, H. H. Young¹ "carried out a total bilateral excision of the seminal tract by a suprapubic retrocystic extraperitoneal operation." The suprapubic approach proved unsatisfactory, owing to tuberculous infection of the wound and the poor drainage afforded.

In 1901 Young² analysed the results of 32 cases reported in the literature, and found these so bad that he thought the operation was not justified, but during the next fifteen years he found the results of more limited operations to be so unsatisfactory, and the sufferings of the patients during the later stages of the disease to be so great, that he returned to the attack and evolved the radical operation which he has now successfully performed in many cases. His plan is:

"(1) Complete excision of lateral lobes of prostate, seminal vesicles, ampullæ, and lower portions of vasa deferentia through the perineum without opening the urinary tract. (2) Excision of remainder of vas deferens, epididymis (and testicle, if involved) through the groin or scrotum."

Operation. Anæsthesia. Owing to the risk of reawakening pulmonary tuberculosis, a general anæsthetic is rarely indicated, and sacral anæsthesia is quite satisfactory except for the removal of the vas deferens through the groin near the end of the operation. This part can be

¹ *Ann. of Surg.*, 1900, xxxii, 557.

² *Practice of Urology*, 1926, ii, 515.

anæsthetised by injecting the cord in the inguinal canal with novocaine. For the sacral anæsthesia about 15 to 20 c.c. of a 3 per cent solution of novocaine are injected into the lower end of the sacral canal this amount of concentrated solution being better than a larger amount of a weaker solution.

First Stage Removal of the Vesiculæ Lower Ends of Vasa Deferentia Ampullæ and Lateral Lobes of the Prostate through the Perineum The patient is placed in the exaggerated perineal position used for perineal prostatectomy. Young's long and delicate urethral tractor is passed along the urethra as far as the apex of the prostate. The same incision is used as for perineal prostatectomy except that its two limbs extend about one and a half inches further backwards to give better exposure. The central tendon of the perineum is defined and divided and the urethra exposed at the apex of the prostate. The tractor is then gently pushed on into the bladder opened and fixed by means of the screw upon its handle.

The assistant by gentle pressure upon the handle of the tractor brings the prostate into view in the perineal wound. The posterior layer of the fascia of Denonvilliers is opened where it covers the apex of the prostate and carefully pushed back with the rectum which it covers and protects. The prostate covered by the pearly white anterior layer of the fascia of Denonvilliers, is thus displayed.

The edges of the levatores ani are retracted or if necessary incised in order to give a better view. Two lateral longitudinal incisions parallel to the urethra and three quarters of an inch apart are made through the anterior layer of the fascia of Denonvilliers cutting into the lateral lobes of the prostate but carefully avoiding the urethra and bladder. These incisions are carried up as far as the base of the prostate. Then an inverted U shaped incision is made through the fascia at this point and the flap thus outlined is dissected back without fear of severe bleeding and above all without danger of opening the pelvic peritoneum or injuring the rectum. By blunt dissection and gentle traction the whole of the posterior surfaces of the vesiculæ seminales are exposed. The vesiculæ and vasa deferentia on either side are separated by blunt dissection in the middle line. The greatest care is necessary to do most of the dissection below and behind the vesiculæ in order to avoid injuring the bladder.

Tapes are passed round the vasa deferentia to be used as tractors When the upper ends of the vesiculæ have been defined their fibrous and vascular attachments at this point are carefully clamped tied and divided. The vasa deferentia are isolated as far as possible with care of the lower ends of the ureters which may be felt but not seen. The vasa deferentia are clamped tied and divided. The clamps are left on at the upper ends until the vasa are avulsed during the second stage of the operation. The lower end of the vasa and the vesiculæ are then turned over and drawn forwards while the lateral lobes of the prostate are gouged out with a sharp spoon. The ejaculatory ducts are then cut across close to the base of the prostate and all the diseased tissues are removed in one mass. The perineal wound is temporarily packed with gauze.

Second Stage Epididymectomy and Avulsion of the Vas through the Groin Unless there are sinuses the incision is made at the base of the

scrotum, just below the external abdominal ring, but, if sinuses are present, the wound is made lower down so that the infected scrotal tissues can be removed together with the diseased epididymis.

The cord is exposed and the testicle delivered inside its coverings. The vas is isolated, the tunica vaginalis opened and the testicle carefully examined; if definitely diseased it is removed in one piece with the epididymis and vas deferens, otherwise it is carefully preserved. If the opposite testicle has been already removed it is particularly important to save the remaining one, or even a healthy portion of it, because of the value of its internal secretion. While separating the epididymis from the testicle it is necessary to avoid the spermatic vessels running on its inner side. If there is any suspicion of tuberculous invasion of the testicle it is well to apply the cautery at the suspected point.

The vas is now separated with the finger introduced into the inguinal canal, and to and fro traction is made upon the two ends of the vas until it moves freely, when it is released from below and drawn out through the groin. In some cases the vas may be so adherent that its complete removal is impossible. It is then wise to drain its lower end through the perineum, and occasionally it is necessary to insert a drain in the anterior wound.

When it is necessary to remove both vasa deferentia and both epididymes, to save time the assistant deals with one side while the surgeon works on the other.

ORCHIDOPEXY

Indications for Operation. (1) The co-existence of a hernia, which cannot be retained properly on account of the malplacement of the testis. In nearly all the cases a potential hernial sac exists, so that a hernia may develop at any time in those in which the serous canal is sufficiently wide or distensible. Such a hernia is peculiarly apt to become strangulated on its first descent.

(2) Attacks of pain, either from twisting of a long mesorchium, which is commonly present, or from nipping at the external ring, or pressure within the canal. Strangulation and gangrene of the testicle may occur from twisting.

(3) Age. It is rarely of use to attempt to bring the testis down after puberty (*vide infra*). It is better to remove it after this age, when only one testis is retained and causing trouble. At one time it was necessary to save the testicle to gain admission into the Army or Navy; now it is only necessary to cure the associated hernia, and the testis may be removed if desirable.

(4) Retention in the canal or at the external ring, but not when the testis is within the abdomen, for the cord is too short.

One or two preliminary questions arise here: What is the value of the retained or ectopic testicle? At what age ought the operation to be performed? These may be answered together. It will be seen by reference to Mr. Jacobson's *Diseases of the Male Organs of Generation* on the condition of the retained or ectopic testicle, if nothing be done, that the following are certain: (a) that such a testicle ultimately becomes, and usually before adult life is reached, physiologically useless; (b) that, as some of the cases I have given show, during the early years of

life the testicle though ill developed may be capable under more natural surroundings of becoming a useful organ (c) that the period in which the testicle passes from a probably useful into a useless state must be an uncertain one varying with the attacks of inflammation &c Most French surgeons have advised deferring the operation until the age of about sixteen as up till this time a retained testicle may still descend While this is true I should strongly advocate resort to operation at an earlier date a step which I have taken in the cases given below on the following grounds It must always be quite uncertain at what date structural changes marring the efficiency of a testicle have set in These must depend on the number of recurrent inflammatory attacks and children are certainly not exempt from these Again in cases complicated with a hernia the longer an operation is deferred the more difficult will it be to ensure a radical cure Moreover a condition of this kind, interfering as it may do with activity and enjoyment of life schooling apprenticeship &c should be put right as soon as possible Finally if the testicle's growth and development are to be furthered by the transplantation and this is one great object of the operation—it is surely more probable that this end will be secured by bringing the testicle into its natural home before puberty that important epoch and its consequent sexual changes have set in I should prefer operating between the ages of eight and nine though in the case of the children of the poor where time is of great importance I should consider it quite justifiable to operate earlier especially if there has been any attack of pain or if a troublesome hernia co exists Before the age of two and three years the small size of the parts their fragility as far as holding sutures go and the difficulty of maintaining asepsis are contra indications to operative interference The following remarks and description of the operation recommended are taken from Mr Philip Turner's monograph¹

In a good many cases the testicle does not develop but shows evidence of further atrophy and may become merely a small fibroid nodule this is generally associated with retraction towards its former position but may occur even though it remains in the scrotum This atrophic change is probably due to injury to the testicle and interference with its blood supply Even a normal testicle is a delicate structure and in an imperfectly descended and developed organ which it is hoped will after transplantation undergo further development the injury produced by transfixion and incision of its substance by sutures and the interference with its blood supply by tension on the cord are likely to imperil this desired result²

Mr McAdam Eccles (*The Imperfectly Descended Testis* p 39) thus sums up the results of the operation —

In a certain proportion of such cases it will grow and develop so as to become in the future a thoroughly efficient organ The exact number of

¹ *Inguinal Hernia the Imperfectly Descended Testicle and Varicocele* (J & A Church II)

² Mr L. B. Rawling *The Surgical Treatment of the Incompletely Descended Testis Practitioner* 1908 lxxxii p 50 investigated the results in a series of forty cases He classifies them as follows —

4 cases
3 cases
8 cases
25 cases

Far results
Promised favourably
Not traced
Failures

instances in which this happy termination does occur is unknown, because there are no proper statistics on the subject. But, from the after-inspection of not a few cases where the testis has been transplanted into the scrotum at the same time that a radical operation has been performed upon the accompanying inguinal hernia, it has been found that the testis has a very great tendency to mount again into the region of the superficial ring, if not actually into the inguinal canal itself, particularly if the case is observed some years after the initial operation. With regard to the second half of the question (that of the possibility of further growth and development), if the testis does remain in position, it will in some instances undergo development; but, on the other hand, should it be retracted, it will as certainly become more atrophied, or, at any rate, not develop. There is here, once more, a significant want of definite record of the subsequent history of these cases, and those that have been traced have not given the operator too much satisfaction."

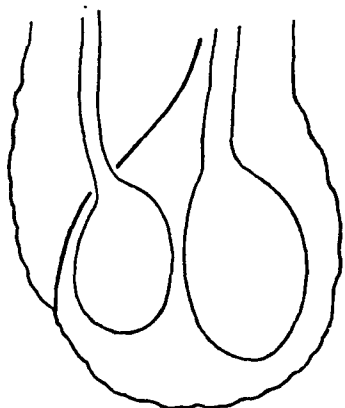


FIG. 409. Orchidopexy. Coronal section of scrotum and testes.

To sum up, the reasons for the disappointing results of orchidopexy, as performed in the usual way, are as follows:—

(1) Injury to the testicular tissues by sutures. There must always be a good deal of tension on these, and this must cause injury and laceration, which will be followed by an inflammatory reaction.

(2) Injury to the veins and interference with the blood supply. Apart from division of any veins, the suture, especially when attached to the thigh or a wire cage, must tightly stretch these vessels and seriously interfere with circulation.

(3) The lack of any persistent force to counteract the tendency of the testicle to retract after removal of the retaining suture.

(4) Injury to the vas. This structure is very rarely so short as to prevent transplantation. Indeed, it very often forms a loop below the testicle, and may be here injured during the division of its lower attachments. It has also been recommended, when the vas is unduly short, that the epididymis may be dissected away from the testicle with a view to providing additional length, so that the globus minor is uppermost. Such a proceeding is unlikely to be successful, and the injury is likely to lead to atrophy.

(5) Failure to divide the gubernaculum or fascial bands.

(6) An undeveloped condition of the affected side of the scrotum. This is often an important factor, especially in unilateral cases.

For the past few years I have attempted to overcome these adverse conditions by transplanting the testicle through the septum to the opposite side of the scrotum. In unilateral cases the affected side of the scrotum is often badly developed, and frequently the median raphe will be found to be directed obliquely or even nearly horizontally. In any case there is always plenty of room for both testicles in one compartment of the scrotum.

No stitches are required to hold the testis in its new position, it is prevented from retracting by the smallness of the opening in the septum. The elastic action of the septum and the weight of the scrotum and the normal testicle supply a slight but continuous force of indefinite duration which counteracts the tendency to retraction (Fig 409). The importance of free division of the gubernaculum and fascial bands extreme care in manipulating the testis and preservation of the vas and veins has already been insisted upon and these, together with the enclosure wherever possible, of the testicle in a tunica vaginalis, are all carefully attended to in the course of the operation.

Where both sides are affected it is possible in some cases, to operate upon one side, transplanting the testicle to the opposite side of the scrotum and then after a suitable interval to repeat the process on the other side so that the right testicle occupies the left, and the left testicle the right compartment of the scrotum.

Operation The procedure is exactly the same whether a definite hernia is present or not in the latter case there is practically certain to be a potential or unoccupied hernial sac which will require exactly the same treatment. The early stages follow closely the lines of the operation for the cure of inguinal hernia described in Chapter II and hence will not require a detailed description.

For convenience the operation will be described on the right side in a boy aged twelve years with a testicle arrested in the inguinal canal but which occasionally presents at the external ring. A similar operation can be performed for most cases of ectopia testis.

(1) *Exposure of the Testicle and Hernial Sac* The skin incision about three inches in length runs slightly above and parallel to Poupart's ligament, and ends below just above the spine of the pubis. The external oblique aponeurosis is exposed by freeing the edges of the incision in the superficial tissues and the external abdominal ring will be identified in the lower part of the wound. An incision about an inch in length is made in the aponeurosis in the direction of its fibres above and to the outer side of the ring ending some little distance above this so as not to divide the intercolumnar ligament. The external oblique is now separated from the internal oblique and the lower border of the latter muscle, which is probably a good deal thinned out is retracted so as to bring the cremaster into view. This is torn through by means of a blunt dissector, so that the spermatic cord and sac bound together by the infundibuliform fascia, and possibly the testicle also, are exposed just below the internal abdominal ring. These structures are now seized by dissecting forceps and are drawn forwards, the cremaster being peeled off in a transverse direction until the cord and sac, enclosed in their fascial sheath are completely freed, and can be displaced from the inguinal canal through the incision in the external oblique. When this has been done a pair of forceps placed behind the cord will prevent it slipping back into the canal. Retraction of the lower border of the internal oblique is now no longer required.

(2) *Separation and Removal of the Hernial Sac* The sheath of infundibuliform fascia is carefully torn through in a longitudinal direction for about an inch. This will bring the veins of the spermatic plexus distinctly into view, and possibly the edge of the sac may also be seen at once. Care

is necessary at this stage to make sure that the sac itself is not torn open. As soon as the edge of the sac is seen it is secured by a pair of Spencer-Wells' forceps: if there is any difficulty in identifying this edge, the left forefinger should be placed beneath the cord and the structures be well spread out over it. When the edge of the sac has been identified and secured the veins and the vas are peeled away, in a transverse direction, with the help of a blunt dissector. A short length of the sac is, in this way, completely separated from the structures which form the cord, and, when this has been accomplished, the blunt dissector, aided by wiping movements with gauze, will readily complete the separation up to the

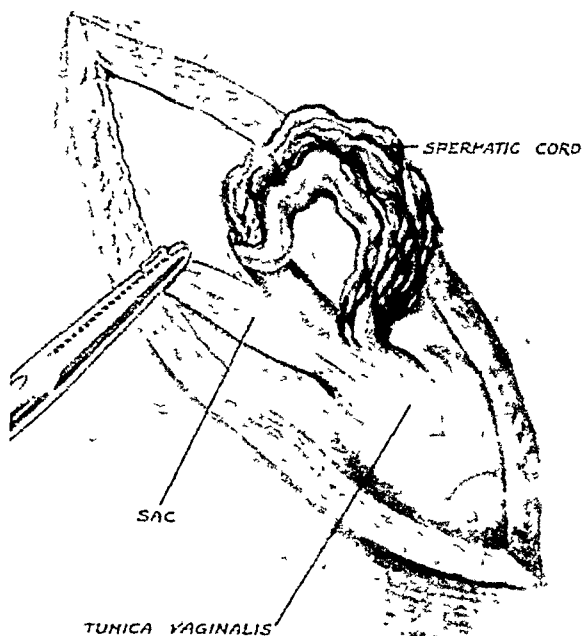


FIG. 410. Orchidopexy.

level of the internal abdominal ring. The sac is ligatured in the way and at the level already described (Chapter II.), and after the sac, a little lower down, has been secured by a pair of Spencer-Wells' forceps, it is divided between these and the ligature (Fig. 410). The stump slips up beneath the internal oblique, and the most essential part of the cure of the hernia has been completed.

(3) *Closure of the Tunica Vaginalis.* The lower portion of the sac is now separated from the vas and veins until the level of the upper end of the epididymis is reached. It is here again transfixed, ligatured and cut through on the proximal side of the ligature (Fig. 411). In this way that part of the sac between the internal abdominal ring and the epididymis is removed, and the testicle remains enclosed in a peritoneal bag, which forms the tunica vaginalis. This covering protects the testicle during the manipulations of the later stages of the operation, and also

will allow it some degree of mobility when it is transplanted to its new position. Though desirable this closure of the lower end of the sac is not essential and if owing to thinness of the peritoneum the tunica vaginalis becomes lacerated to such an extent that it cannot be closed either by transfixion and ligature or by a simple purse string suture it is best to leave it open. Indeed if a definite hydrocele be present no attempt should be made to reconstruct the tunica vaginalis but this should be treated as in the operation for the cure of hydrocele.

(4) *Division of the Gubernaculum and Fascial Bands* The lower attachments of the gubernaculum are now put upon the stretch by pulling

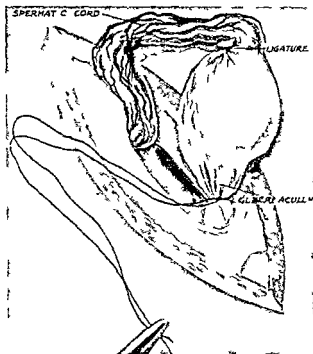


FIG 411 Orchidopexy

on the tunica vaginalis and testicle. The strength and extent of these vary a good deal but as a rule they can be torn through which has the advantage that it is less likely to be followed by bleeding than when knife or scissors have to be employed. After separation the gubernaculum is transfixed and ligatured by a needle threaded with strong catgut; this as a rule should also pass through the lower part of the tunica vaginalis (Fig 411). The downward prolongation and the size of this structure enable this to be done without fear of injury to the testicle. It is important however to remember that the vas often forms a loop which extends in the tunica vaginalis for some distance below the epididymis; this can be detected by inspection and palpation and when this is done it is easy to make sure that it is not included in the ligature. This ligature is not cut short but the extremities of the free ends each of which should be about six inches in length are secured by a pair of Spencer Wells forceps.

The cord is next inspected, and any fascial bands remaining from the sheaths of cremasteric and infundibuliform fasciæ, which become tense and prevent the descent of the testis, are torn across or divided. It has already been pointed out that shortness of the veins is an unusual complication, and that insufficient length of the vas is a still rarer condition. When these unusual hindrances to transplantation are present the testicle is usually arrested within the abdomen, and, in any case, they will have been recognised at an earlier stage in the operation, and

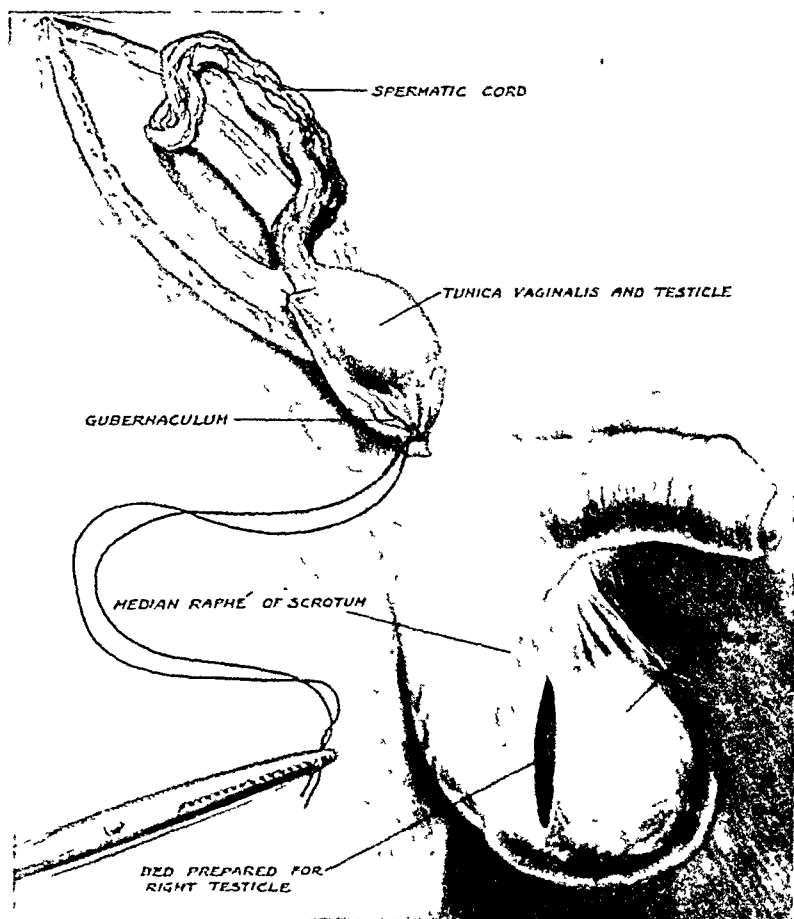


FIG. 412. Orchidopexy.

the testicle will then be disposed of upon the lines already indicated. The testicle, enclosed in the tunica vaginalis, is now only attached by the vessels and the vas, and it is covered with gauze soaked in hot sterile saline during the next stage of the operation.

(5) *Preparation of a Bed for the Testicle in the opposite side of the Scrotum.* An incision, about an inch in length, is made in a vertical direction on the anterior aspect of the opposite side of the scrotum (Fig. 412). Since we are considering an operation for right imperfectly descended testicle, this incision will be on the left side; it is most conveniently made by squeezing the left testicle forwards, so as to make the skin tense.

The superficial tissues are divided through the whole length down to the fibrous sheath of the tunica vaginalis but care must be taken not to injure this structure. When the cellular tissue has been well opened up the margins of the skin incision are retracted by two pairs of tissue forceps and after any bleeding vessels have been secured a space is cleared by a blunt dissector or the finger between the septum of the scrotum and the left tunica vaginalis. The connective tissue is very loose and an ample

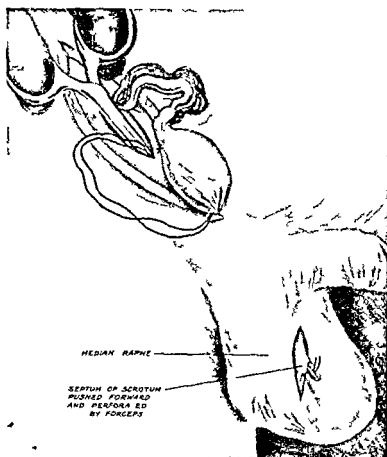


FIG 413 Orchidopexy

bed can readily be prepared while doing this there is no danger either of opening the tunica vaginalis or of damaging the testis.

(6) *Transplanting the Testicle* The forceps gripping the ends of the long ligature are now passed through the incision in the external oblique aponeurosis and are pushed through the external abdominal ring well down into the scrotum. The closed blades of the forceps are next pressed inwards so as to impinge upon the right side of the septum of the scrotum near its centre and then by manipulation of the handle they are made to present in the scrotal wound pushing the septum before them (Fig 413). A small incision is now made with a knife in the septum over the end of the forceps with the result that the blades with the ends of the ligature are

pushed right through into the scrotal wound. When the ends of the ligature have been secured, the forceps are unclipped, and are slowly withdrawn; while this is being done, the blades are opened out so as to stretch open the soft parts and make a channel along which the testicle can pass to its bed on the left side of the scrotum. Though the passage from the inguinal canal to the septum may be freely dilated, care must be taken not to tear the open wound in the septum too widely; it is better to have

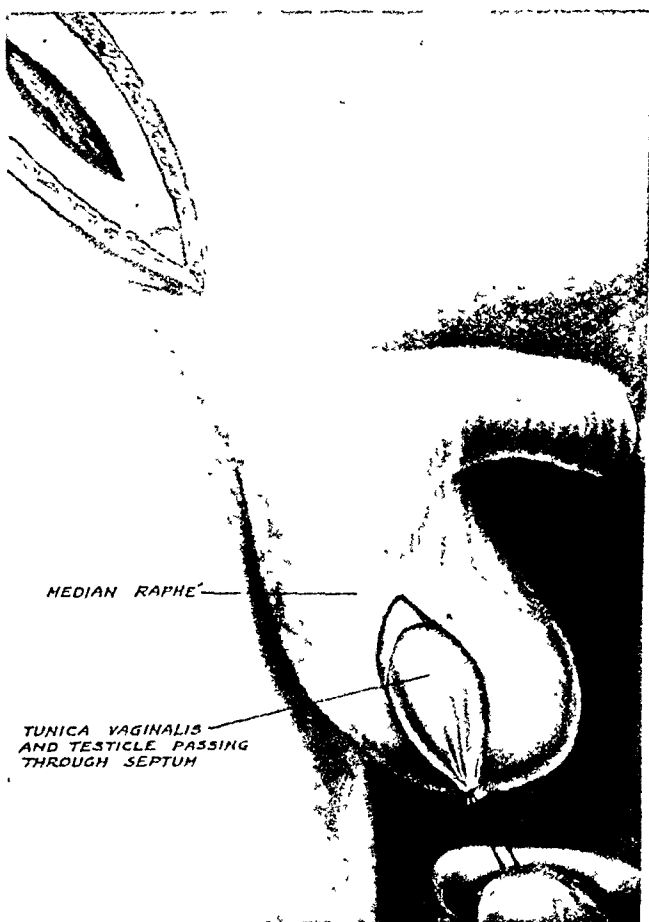


FIG. 414. Orchidopexy.

this rather too small and to enlarge it later if the testis cannot be drawn through it.

The testicle is now replaced in the inguinal canal, and, by steady traction on the free ends of the ligature, aided by pressure from above, it readily passes along the channel made by the forceps as far as the septum. When it arrives here, the pull exerted on the tunica vaginalis makes this assume a somewhat conical shape, the enlarged basal portion of which is formed by the testicle. The narrow pointed portion of the cone, formed by the tunica vaginalis alone, readily passes through the small opening in the septum; steady traction from below, aided by gentle pressure from above, gradually dilates the opening, and presently

the testicle slips through (Fig 414) As soon as this has happened, the elastic character of the septum causes the opening to contract, and thus to prevent any return to the old position If the opening in the septum should be too small to allow the testicle to pass through, the traction may be relaxed, and a director, guided by the ligature, may be slipped through the opening, which is slightly enlarged by a knife run along the groove Renewed traction will now draw the testis through into its bed It will be seen that if the initial opening in the septum be too large, the testicle might partially, or even completely, retract through it No sutures are required to fix the testicle in its new position, it is simply placed in the prepared bed, which is finally washed out with hot saline solution

At first there will, in many cases, be a tendency for the septum to be drawn upwards, but retraction to the old position will be resisted by the elasticity of the septum and the weight of the scrotum and normally placed testicle of the left side This force, though slight, is constantly being exerted, and is of long duration, while fixation by stitches can only act for a few days, until the sutures are removed or cut out It will be noticed that the channel made for the spermatic cord passes beneath and at some distance from the urethra

(7) *Closure of the Wounds* The wound in the scrotum is closed by a few silkworm gut stitches, care being taken that the edges are not inverted The wound in the groin is closed in the same manner as in the operation for hernia, the incision in the aponeurosis is sutured with fine catgut, and this should be continued down to approximate the pillars if the external ring is unduly large The incision in the superficial tissues is then sutured and the dressing applied

The Results of the Operation It must be admitted that in a certain proportion of the cases, the local condition does not allow of anything like a perfect result too much must not be expected from the operation either by the surgeon or the patient In an ideal result of an operation for imperfectly descended testicle the following conditions would be fulfilled (1) The testicle should remain in its new position in the scrotum (2) All complications should be cured and all symptoms relieved (3) It should either develop, or regain, its normal functions

With regard to the first of these conditions, although, owing to the war, I have not been able to keep my cases under prolonged observation, I have no hesitation in saying that, in the great majority of cases in which transplantation to the opposite side has been carried out, the testicle does remain in the scrotum, and that the results in this respect are greatly superior to those of the ordinary operation of orchidopexy

As regards complications and symptoms, it may be confidently stated that any complication, such as hernia or hydrocele, will be cured Though some slight tenderness may persist for some time, it is unusual for there to be any severe pain, and a gradual diminution and disappearance, both of pain and tenderness, may be expected These symptoms depend upon the position of the testicle, being slightly marked or absent in the first group, and tending to persist for a longer time in the second and, especially, the third I have never been called upon to remove a testicle which has been transplanted in this way

With reference to the third point, the return of function, nothing can be added to what has already been said I have certainly noticed

some increase in size in several cases, but this, of course, does not by any means necessarily mean a functional development.

Mr. Corner¹ prefers replacement of the retained testis within the abdomen to orchidopexy, because he believes that the retained testis rarely becomes functional, and that the internal secretion of the organ is retained just as well after abdominal replacement. I do not agree with these views, but prefer to perform orchidopexy for suitable cases, for this is more likely to be followed by development of the testis, if undertaken well before the age of puberty. Experiments upon animals tend to show that the normal testis atrophies if replaced within the abdomen before the age of maturity. Moreover, a testicle inside the abdomen has given rise to peritonitis as a result of ascending infection in gonorrhœa; hæmatoma of the testes has followed injuries of the lower abdomen, and growth of testis has occurred. Moreover, the testicle has descended into the canal together with a hernia in some cases. On account of severe pain and disability I have had to remove several testicles which had been placed in the abdomen. I should replace the testicle in the abdomen only when it is the only testicle and then causes pain, is associated with hernia and cannot be brought down out of the canal.

¹ *Brit. Med. Journ.*, June 4, 1904.

CHAPTER XXVIII

OPERATIONS ON THE ANUS AND RECTUM

Preparation. To lessen the unusual risk of septic infection which is associated with operations on the anus and rectum, and to diminish the post-operative discomfort, it is of great importance to prepare the patient adequately before the operation, especially before excision of the rectum for growth. The patient should be at rest, but not necessarily in bed, for several days (up to a week before excision of the rectum) before the operation, and on light, easily digested food which leaves but little residue. Milk in moderation, eggs, butter, cream, sugar, jelly, soup, olive oil, Benger's food are valuable. The colon must be emptied as far as possible by giving a dose of castor oil $\overline{3i}$ thirty six hours before the operation, followed, if necessary, by $\overline{3i}$ to $\overline{3u}$ of Magnesium or sodium sulphate. When there is obstruction one or more water or saline enemata are usually necessary. No laxative should be given for twenty four hours before the operation, but on the contrary peristalsis is to be inhibited by the administration of opium. The rectum and colon are thoroughly emptied by means of an enema given about twelve hours before the time fixed for the operation. If these precautions are taken, the bowels rarely act during or soon after the operation, and the wound is less likely to become infected. Salol may be given by the mouth, and weak antiseptic solutions may be used to irrigate the rectum in septic cases.

ISCHIO-RECTAL ABSCESS

It is imperative to open all ischio rectal abscesses without delay in order to avoid the formation of fistulae and extensive sinuses. The overlapping flaps of skin are to be excised so as to lay the cavity well open and to avoid the need of plugging, which is a painful and dangerous process, too often leading to the formation of fistulae. A surface dressing of gauze and vaseline and the frequent use of the bath brings an easy, rapid and complete cure ¹

FISTULA

Varieties. As these have a very practical bearing upon the operation they must be alluded to here.

(i) *Complete* (ii) *Blind External*. Here an external opening only exists, though in a considerable number of cases the internal opening is overlooked. (iii) *Blind Internal*. An opening through the mucous

¹ Lockhart Mummery, *Clinical Journal*, 1923, ii, 556

membrane is here the only one. This is the rarest, but an important variety, as, if overlooked, it is certain to be troublesome.

A discoloured spot or patch of skin sometimes marks the place where an external opening may occur. Mr. Lund¹ relates a case in which a very chronic and slowly advancing blind internal fistula had excited, by its extreme end, just enough inflammatory thickening of the skin to imitate a keloid growth, for which it was at first mistaken.

Situation of Openings. Both of these are usually within an inch, more often half an inch, of the anus. The internal one may be detected as a slight depression or papilla by the finger, or by the speculum, or, in obscurer cases, by the proctoscope.

Horseshoe Fistulæ. Here an external opening on either side communicates with a single internal one, often at the back. This is an uncommon but an important variety for, if the bridge be cut through on both sides, loss of anal control is very likely to ensue. It is better to make a free opening on one side, and to scrape and pack the other limb of the fistula from the opening. The sphincters should not be divided completely on either side, for incontinence has often followed this mistake. There is not the same objection to dividing the external sphincter in the middle line behind, when this is necessary for free drainage.²

Multiple Fistulæ. This condition should always cause a suspicion of stricture or extensive ulceration, *e.g.* syphilitic, tuberculous or malignant.

Fistula with Tuberculosis. When a fistula presents an external opening with undermined, livid edges, where the tubera ischii stand out prominently from emaciated nates, tuberculosis is always to be suspected, even if no history of cough or hæmoptysis is given.

Question of Operating on Phthisical Patients. While each case must be decided by itself, the following remarks may be useful :

Where the phthisis is advanced, the cough incessant, the fistula multiple or branched, an operation is out of the question. On the other hand, where the physical signs are little marked, night sweats slight or absent, where the fistula interferes with the patient taking the all-essential exercise, where the power of repair is good, an operation is indicated. Not all anal fistulæ in tuberculous patients are tuberculous, but many are the results of ordinary neglected ischio-rectal abscesses.

Before operating the surgeon should remember that repair is here often sluggish, the mental condition much depressed. He should do all he can to improve the general condition before and after the operation. And if this can be performed in sunny weather, or, better still, in the country or at the seaside, so that the patient can soon have fresh air in the recumbent position, so much the better. Whenever possible a general anæsthetic should be avoided.

Operation. The patient being either on his side with the knees well flexed, or better in lithotomy position, the surgeon introduces lightly a probe-pointed pliable director. In the case of a complete fistula, the internal opening being hit off, the point of the instrument is felt for by the finger and hooked out of the anus. If, after careful examination,

¹ *Hunt. Lect.*, p. 88.

² Mr. Cripps (*Dis. of Rectum and Anus*, p. 165) shows that if, in women, the sphincter is cut through anteriorly, where it decussates with the sphincter vaginae, incontinence of faeces is very likely to take place.

the surgeon cannot find an internal opening he must not make one but should open the sinus freely along the director and remove all overhanging edges of skin as well as the lining of the whole track leaving only a saucer shaped cavity instead of the usual deep fissure which is so ill-drained and so difficult to heal (Fig 415) Fistula in ano frequently recurs chiefly on account of incomplete removal of the suppurating sinuses and imperfect after treatment

In the case of a blind internal fistula the internal opening must be found with a speculum and a curved probe passed from this so as to project beneath the skin In every case the whole length of the sinus between skin and bowel must be completely laid open by dividing the bridge raised by the grooved director or probe When this has been done very careful examination is made for other sinuses by the introduction of the probe and by pressure with the finger which squeezes out any

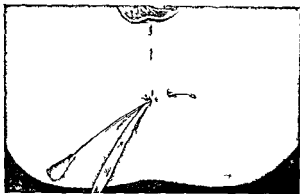


FIG 415 Operat on for fistula n ano

discharge and feels for indurated tracks Wherever these run they must if possible be laid open I have already alluded to the question of avoiding division of the sphincter and whenever possible It is also important not to carry the incision higher into the bowel than is absolutely necessary but free drainage must be provided by prolonging the incision far enough outwards into the ischio rectal fossa Every attempt however should be made with the aid of a good light and retraction to lay open every sinus extra care being taken the higher the incision has to be carried to arrest all bleeding

While the sinuses are being followed up any old gristly tissue must be completely removed all pyogenic or granulation tissue excised or entirely scraped out and every ill nourished flap and tag of undermined skin cut away If any troublesome piles co exist they should be removed at the same time

A strip of sterilised gauze or cotton wool smeared with aseptic vaseline is lightly applied to the wound and covered with a sterile pad The bowels are kept acting once daily and immediately after the action the parts are soaked and cleansed in the bath The dressing comes off without pain and is renewed when the patient returns to bed Tight packing is to be avoided because it hurts and delays healing

Excision and Immediate Union of Fistulæ. Mr. Reeves recommended this treatment some years ago.¹ It certainly has the advantage of often shortening the treatment greatly and preventing loss of the sphincter power, but at the risk of two dangers: (1) Sepsis. (2) The part within the bowel is sometimes difficult to suture satisfactorily, and may persist as a sinus later. The method may be tried in simple cases which do not extend far into the bowel.

Operation. The anus having been well dilated, the fistula is laid opened and its walls excised. Any skin or mucous membrane which is unhealthy or which will get between the edges of the wound must be snipped away and the bleeding stopped. The wound is closed in its whole extent by sutures, which must underrun the wound, so that the depth of the latter may be efficiently closed. These are left in for a week or ten days.

HÆMORRHOIDS

Indications. (1) Continuance of hæmorrhage or discharge, and persistent liability to descent of piles in spite of judicious treatment. Prolapse of the hæmorrhoids may interfere with sitting, walking and riding.

(2) Repeated attacks of strangulation and thrombosis of the prolapsed piles. When prolapsed piles thrombose and are irreducible, they cause great pain and misery which may continue for some weeks and end in sloughing and suppuration. It is better to remove them at once and thus save unnecessary pain and the waste of some weeks of valuable time.

(3) Severe pain from associated fissure of the anus, or prolapse of the rectal mucosa.

(4) Absence of enlargement of the liver due to cirrhosis, cancer or other disease, causing obstruction of the portal vein or of its tributaries in the colon or rectum. Every care must be taken to exclude such causes of symptomatic piles when removal is useless and vexatious. In many cases cancer of the upper part of the rectum or pelvic colon, as the cause of piles, has been overlooked with sad results.

OPERATIONS. Injection of Carbolic Acid—Ligature and Excision—Cautery—Excision and Suture—Whitehead's Operation.

(i.) **Injection of Carbolic Acid.** The symptoms of uncomplicated internal piles of moderate or small size can be relieved or even cured by injecting the piles with 10 to 20 per cent. carbolic acid dissolved in equal parts of glycerine and water or with 5 per cent. to 10 per cent. quinine-urea hydrochloride. The latter is attended with less discomfort and is said by American surgeons to be as effective as the former, which is the solution almost invariably preferred by English surgeons. Bleeding is especially amenable to this treatment and is usually arrested by one injection. Prolapse and other symptoms are also corrected, at least for a time, sometimes permanently. Most adults have internal piles but do not know it until they bleed, prolapse or thrombose. They do not matter when they give no trouble and, from this point of view, the patient is usually satisfied with the results of the injection treatment. Even if the symptoms recur he does not mind the repetition of a treatment which

¹ *Brit. Med. Journ.*, 1887, i, 917.

needs neither anæsthetic nor rest from work. Many patients cannot or will not have an operation for piles, they only want to have their symptoms relieved so that they can carry on with their work.

The injection treatment is particularly suitable for the treatment of a single bleeding pile and for old and feeble patients or others unsuitable for operation. The chief disadvantages and limitations are

(1) That, in more than half the cases, symptoms recur sooner or later, calling for further injections or for the radical operation.

(2) That only a small proportion of cases of piles are suitable for this method. The piles must be uncomplicated, not inflamed and not too large, they must not be associated with external piles for the latter may slough after injection of the communicating internal piles.

(3) There must be no sugar in the urine for sloughing has followed the incautious use of this method in diabetics.

Technic. Great care is required in carrying out the injection properly, asepsis and accuracy of injection being observed and above all, the solution used must be neither too strong nor too abundant. Severe hæmorrhage, painful thrombosis, even disastrous and deep sloughing, fissure, abscess and fistula have followed the improper use of this method—especially the use of too strong solutions or the choice of unsuitable cases.

After the usual preparation and cleansing a fenestrated rectal speculum is greased with sterilised vaseline and introduced and a pile projecting through the window in the speculum is seized by a special small clamp and two to six minims of the 10 per cent. solution of carbolic acid is injected into the centre of the pile near its base. From one to five piles may be treated in this way. Very little inconvenience follows the injection of one or two piles, the patient being able to return to work the next day, being allowed full diet and getting normal actions of the bowel without the need of aperients. If only one or two piles are injected at the first sitting the rest may be done after three or four days. Some surgeons repeat the injections of each pile three or four times, the whole treatment taking a month, but the patient is able to do his work all the time. After this methodical and repeated injection recurrence of symptoms is rare.

(11) *Ligature.* When properly used this is a very easy, rapid and good method. Here as elsewhere that surgeon will have the best results who has thoroughly familiarised himself with the detail of one operation. The following appears to me to be a fair way of putting the comparative merits of the ligature and the cautery.

(1) In my opinion the ligature is more generally suited to all cases. Again, it can be more easily applied to piles high up than can the cautery. (2) No special instruments are needed. (3) A ligature applied is done once for all, the cautery may have to be reapplied more than once if bleeding follows when the clamp is unscrewed. (4) The risk of bleeding is less and hence this method is especially advantageous in anæmic patients. (5) The ligature is free from the objections to the cautery in private practice, viz. the smell and the need of a cumbersome apparatus otherwise rarely used.

Operation. The preparatory treatment is that given at p. 757 and is of great importance. The patient being in the lithotomy position and

well relaxed under ether, the anus should be gently dilated.¹ There is rarely any need to stretch the sphincter. When the piles have been displayed the surgeon decides how many there are to remove and at once fixes an artery forceps on each of them. The piles which lie lowest according to the patient's position² are drawn down with artery forceps, and the surgeon with blunt-pointed scissors, curved on the flat, cuts a groove around the lower two-thirds of the pile, which is then separated from the submucous and muscular coats by blunt dissection. The object of this deep groove is twofold: it forms a bed in which the ligature can be sunk tightly, and, above all, it leaves a very small pedicle of tissues to be strangled. The groove, moreover, can be cut without risk of hæmorrhage, as, however large the pile, its vessels enter it from above, running into its upper part just beneath the mucous membrane. The surgeon then ties round each pile, which is now still further dragged down, a ligature of strong catgut. Sinking this into the groove, he tightens it up so as to embed his ligatures firmly, without cutting through the pedicle. About two-thirds of the pile are then cut away, enough being always left to ensure a safe hold for the ligature. In Allingham's *Diseases of the Rectum* (p. 146), the following most important practical point is insisted on. When the piles are separated from the bowel preparatory to applying the ligature, it is essential that the base to be ligatured should be as narrow as is consistent with safe securing of its blood supply. For if many piles have to be tied, and their bases are left large and broad, when tied up they draw the mucous membrane together and cause great narrowing of the rectum. In such a case it is almost impossible to introduce the finger, without force, beyond the parts tied. In other words, islets of untied mucous membrane, as wide as possible, should always be left between the tied piles. This will secure less pain, easier action of the bowels, and less risk of contraction. After every internal pile has been carefully treated in this way, the external ones are clipped away, care being taken not to encroach upon the junction of skin and mucous membrane, and not to remove subcutaneous tissue for fear of subsequent contraction. If any bleeding-points still persist, they should now be tied, cut and, lastly, the stumps of the piles are returned. A dressing of sterilised vaseline gauze and wool is applied, and firm pressure made with a T-bandage.

(iii.) **Clamp and Cautery.** The preparatory treatment and position of the patient are those already given. The piles having been sufficiently protruded and the anus forcibly dilated, they are drawn well down, one by one, with vulsellum forceps, and enclosed within the blades of the clamp, which is screwed tightly up. With scissors curved on the flat the pile is then so cut away as to leave a sufficient stump. This is then thoroughly seared down with a cautery, carefully kept at a dull red heat. If the iron sticks at any moment, owing to its cooling down, it should not be pulled away, but loosened by heating it a little. The clamp-screw is then slightly relaxed, and if any bleeding takes place it

¹ The version of the rectal mucous membrane by the finger in the vagina will often be most useful in bringing piles within reach.

² The sigmoid prevents the other hæmorrhoids being obscured with blood. Mr. Allingham states that the smallest piles should be taken first, as there is a danger of these being obliterated and thus leading to a recurrence of the disorder.

is at once tightened up, and the cautery reapplied. Every care must be taken to burn down the stump thoroughly at the first attempt for, if this fail and oozing take place, it is not easy to stop the bleeding, from the tendency of the stump to slip through the slackened clamp. The piles having been successively dealt with in this way, the stumps are smeared with sterilised vaseline and pushed back.

This method is thought by some to secure more rapid healing with less pain than the ligature. This however true of the old methods, does not hold good when the piles are freely detached and the ligatures tied with the precautions already given. The clamp is less easily manipulated in the rectum. It is a special instrument not always at hand, and the smell entailed by the cautery is most unpleasant. The surgeon who uses it must be extremely careful to keep his seared surfaces as small as possible, and by no means to entrench upon the skin. It is well known how slowly, how painfully and with what a tendency to contraction burns heal. The cautery is a troublesome instrument to carry about and not infrequently gets out of working order just when it is most wanted, and for no very obvious reason. I greatly prefer to use the more exact, simple and comparatively painless ligature or excision and suture methods, except for strangulated sloughing piles, when the cautery is perhaps preferable. The cautery ensures asepsis at the time of the operation, and hence it was a comparatively safe method before the days of aseptic operations but the slough must separate by ulceration, which makes the convalescence of the patient more painful and uncertain after this than after the ligature method.

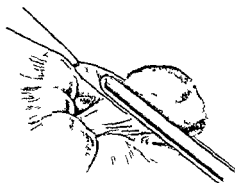


FIG 416. Excision and suture operation for piles. The first turn of the suture secures the main artery as it enters the pile.

(iv) **Excision and Suture** Sir Robert Jones published the following account of this operation.¹

"The hæmorrhoid is placed within the clamp² (Smith's by preference) and cut off, leaving about an eighth of an inch of pedicle. This cut edge is sewed with a catgut suture, the clamp removed and the operation is complete. The best plan is to take a piece of catgut about eighteen inches long, with a needle at each end. One needle is passed through the upper end of the pedicle, and a first knot is tied, then the needles are passed from left to right and right to left, and each time they cross the pedicle they are tied. Except in the case of friable granular hæmorrhoids, I shall not use the cautery again, and I am inclined to believe that stitching the pedicle is more in accord with one's surgical instinct than burning it, which of necessity means the subsequent separation of a slough."

¹ *Proc. Med. Journ.*, 1893 p. 400

² A Mayo-Oschner's artery forceps serves well

Mr. Thelwall Thomas,¹ in 1898. described a similar operation which he had then performed for several years. The great advantages claimed for the operation are (1) that primary union is obtained and so convalescence is more rapid; (2) that reactionary and secondary hæmorrhage are prevented.

Mr. A. B. Mitchell, of Belfast,² also uses a continuous catgut suture, but he only knots it twice, just beyond the extremities of the wound. The first turn secures the main artery before it enters the stump. The tail thread is left long, and the continuous suture is rapidly passed round the clamp, so that the thread gets a wider grip and is more hæmostatic. The clamp is withdrawn when the suture has been placed, and traction is made upon both ends of the thread, so that accurate apposition may

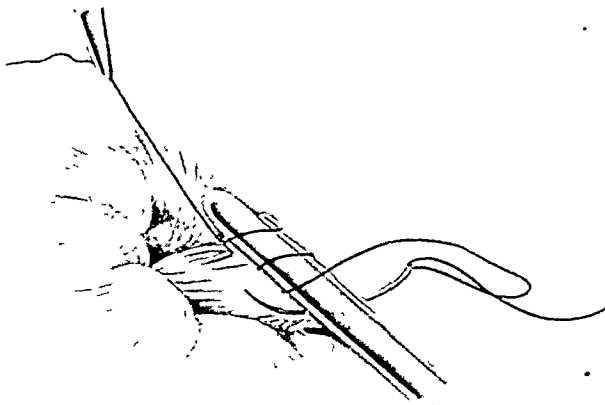


FIG. 417. Excision and suture operation for piles. The forceps are removed and the upper and lower ends of the catgut suture are tied together, thus puckering up the wound and preventing hæmorrhage.

be obtained without puckering of the wound. The lower knot is then tied, and the upper and lower tail ends are cut off (Fig. 417).

Dr. L. S. Pilcher, of New York,³ describes and figures an operation almost identical with that of Mitchell, except that he does not apply the clamp forceps until he has severed the redundant perianal skin below each pile and has separated the lower part of the latter from the sphincter. He removes more of the skin than most surgeons do. This prevents the formation of œdematous tags of skin at the anus.

The excision and suture method with the aid of clamps is suitable for most cases of piles. The operation is a very safe and comparatively easy one, and most surgeons, especially those without much experience, will get far better results from it than from the more severe operation of Mr. Whitehead. When it is used for cases of moderate degree of severity (the majority) the results are excellent, and recurrence, although possible, is very rare.

(v.) **Whitehead's Operation of Excision of the whole "Pile-bearing" Area.**⁴ This extensive operation is intended to bring about a radical

cure, its object being not only to remove any existing piles but also all the mucous membrane in the lowest part of the rectum, which is the seat of piles, owing to the tendency of its veins to become dilated. Though Mr Whitehead performed this operation in 300 cases without a fatal result or any drawback, I consider it needlessly extensive and severe.

The following criticism¹ appears to me soundly based. "Mr Whitehead terms his operation simple. Simple it may be but difficult to perform, for with the anus rugose and elastic as it is even after dilatation of the sphincters it is not at all easy to separate the mucous membrane from the skin. The time required for the operation is an objection, this process takes on an average at least thirty minutes where a skilled



FIG 418 Whitehead's operation. A tube of mucous membrane—the pile bearing area—is isolated.

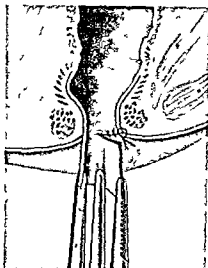


FIG 419 Whitehead's operation. The pile bearing tube is drawn down with pressure forceps and gradually cut away. After each snick with the scissors a stitch is inserted.

surgeon can operate with the ligature in less than five minutes. The hæmorrhage by this method far exceeds the amount lost when the ligature is used, and this is of great importance in those patients who have already lost much blood from their piles. Two or three days after the operation the parts not infrequently become swollen and the mucous membrane then tears at the sutures and retracts away from the skin. This leaves a large granulating surface which may occupy the entire circumference of the bowel, and cause troublesome contraction.

Stricture of the rectum has occasionally followed Whitehead's operation, even when it has been performed by the ablest surgeons. Severe hæmorrhage has also occurred when the stitches have given way and the rectal mucous membrane has retracted. Both these catastrophes should be rare if the suturing be done with great care but even the best work does not always prevent the stitches tearing out. It is fairly common for some temporary loss of anal sensation and control to follow

¹ Allingham *Diseases of the Rectum* p 139

Whitehead's operation. Prolapse of mucous membrane with troublesome mucous discharge occasionally follows, and Lockhart Mummery¹ states that he has seen most recurrences of piles after this operation, which also keeps the patient laid up and away from work for a considerably longer time. Careless operators or those without a knowledge of anatomy have even damaged the sphincter and in separating the mucous membrane. A good many bad and imperfect results have in fact occurred.

Despite these occasional accidents, the operation is a good one when skilfully performed for selected cases; but it is certainly not one to be undertaken lightly by surgeons of little experience. It is especially indicated for extensive and confluent hæmorrhoidal disease with laxity of the anus and some prolapse of the mucosa and chronic inflammation. Such cases are not suitable for less severe and easier methods. Debilitated and very anæmic patients are not favourable subjects for it.

Operation. The patient is carefully prepared as described at the beginning of this chapter. The lithotomy position is adopted.

The sphincters having been thoroughly dilated, and the rectum well cleansed, a temporary plug of gauze is inserted above the field of operation to prevent any possible contamination with fæces. A ligature is attached to the gauze, so that the latter may be easily withdrawn at the end of the operation. The hæmorrhoidal area of mucous membrane is made to prolapse, and the prominent edge is seized with four long hæmostatic forceps, placed at equal distances from each other round the circle. Traction is made with the forceps, while the mucous membrane is divided with blunt-pointed scissors a little above the white line,² where the skin and mucosa meet. If the incision is made too low, the mucous membrane projects below the sphincter, causing moisture, itching and bleeding at the anus. The mucous membrane is then dissected up with forceps and scissors from the external and in part the internal sphincter, till the whole of the pile-producing area of mucous membrane can be pulled down and drawn outside the anus. It is then cut away, bit by bit,³ transversely at its still attached upper border, each portion when divided being at once attached to the cut skin with sterilised silk sutures. In this way the diseased area is removed as a complete ring of mucous membrane.

It is of vital importance to use plenty of sutures both for controlling hæmorrhage, and also for securing firm and accurate apposition. Each suture must also take an ample bite of the rectal mucosa, so that it may not tear out prematurely, and for the same reason the threads must not be too fine.

Bleeding is at once controlled by finger pressure, until another suture is introduced to arrest it. It is not necessary to ligature any vessels. Before completing the operation the entire circular wound is examined, and a stitch is inserted here and there between the primary sutures wherever the apposition is not perfect or any bleeding occurs. This examination is facilitated by traction upon each primary suture in turn. The ends are then cut short, the temporary plug withdrawn and the dressings applied.

¹ *Diseases of the Rectum and Colon*, 1923, p. 219, Fig. 64.

² The "white line" of Mr. Hilton (*Rest and Pain*, p. 289, Figs. 51 and 52).

³ So as to diminish the hæmorrhage, which would otherwise be free at this stage.

After-Treatment Sterilised gauze smeared with sterilised vaseline and a soft pad are held on by a broad perineal T bandage. The dressing is changed twice a day and the parts kept clean by gently swabbing with cotton wool soaked in boracic lotion. Strong antiseptics are avoided because of the danger of itching and eczema. Pain is relieved by aspirin gr x or xv repeated every four hours if necessary. Occasionally morphia gr $\frac{1}{4}$ or heroin gr $\frac{1}{4}$ is required the first night. A rubber hot water bottle applied locally is often very soothing. Full diet is allowed in moderate quantities as soon as the patient can take it. This saves much trouble from flatulence. Paraffin $\overline{3i}$ morning and evening is given after the first day and if necessary castor oil $\overline{3iv}$ to $\overline{3i}$ is given on the third morning followed if required by $\overline{3ii}$ of sodium sulphate six hours later or failing this by an oil enema ($\overline{3vi}$). This should be given through a soft catheter very carefully introduced and attached to a funnel the ordinary enema syringe is much too painful to use. The patient is allowed to use a commode from the first for this is much more humane and effective than a bedpan. A gentle aperient in addition to the paraffin is given every night if necessary. Senna pod tea, confection of senna or aloin pill serves well. After four or five days the morning bath is allowed and is soothing and promotes rapid healing. Sitting up in a soft chair or on a ring cushion is allowed after nine or ten days and gentle walking exercise soon afterwards but the patient is not allowed to take much exercise or to leave the Home or Hospital for at least a fortnight or before the anus is soundly healed. If there are any large inflamed tags of skin which do not shrink they should be injected aseptically with 0.5 per cent novocaine and snipped off painlessly with sharp scissors.

Causes of Failure and Trouble after Operations for Hæmorrhoids

(1) *Hæmorrhage* This will be extremely rare if the precautions which have been mentioned under each operation are carefully observed but it is most likely to follow Whitehead's operation owing to the tearing out of stitches. It used to be not uncommon after the clamp and cautery. It is very rare indeed after the ligature and suture methods. The conditions under which this complication may occur are cases of long standing piles or prolapsus in weakly subjects cases where the tissues are very friable where the patient insists on getting out of bed to pass water or where he strains very much at the first action of the bowels. If the surgeon be called upon to meet it the best means is to catch the vessels with artery forceps and tie them. Failing this the centre of a large piece of antiseptic gauze is pushed well into the rectum and the sacular part of it within the bowel is then filled with gauze strips until a pear-shaped plug is formed. Traction upon the sides of the sac of gauze brings the plug down against the sphincter or anal constriction and effectually controls the hæmorrhage. The strips of gauze are easily removed. Styptics such as $\overline{gr}^{\text{ss}}$ of adrenalin chloride may be applied on the gauze.

(2) *Tedious Ulceration* This is often due to the patient getting up too soon or the use of the clamp and cautery or the ligature method without any sutures for approximation of the mucous edges. The patient should remain in bed a week or ten days and then be content to pass another week or ten days upon the sofa.

(3) *Septic Troubles*. These may follow from want of care in performing the operation, especially in cleansing the rectum very thoroughly.

(4) *Contraction*. This is usually stated to be only likely to occur when in cutting away piles, especially external ones, the junction of skin and mucous membrane is trephined upon. But the fact is that where many piles have had to be removed, where islands of mucous membrane have not been left between them and the ulcerated surfaces thus tend to coalesce, contraction of the surface as it cicatrises is very likely indeed to lead to some narrowing of the lumen of the gut. This must always be prevented by the early passage of the finger of the surgeon in charge, this being repeated daily if any tendency to contraction is found. Where a stricture, generally about one inch and a half from the anus, has been allowed to form, it will generally yield to the use of bougies, aided, if need be, by nicking the contraction.

A serious stricture is most likely to follow Whitehead's operation, from retraction of the rectal mucosa due to the stitches tearing out. This may be due to the use of too few or too fine threads, or to the insufficiency of the bite taken by each suture.

(5) Loss of anal sensation. (6) Loss of perfect control. These most often follow Whitehead's operation.

(7) Abscess. (8) Fistulæ. (9) Inflamed glands in groin. (10) Inflamed tags of skin round the anus. These are given by Mr. Allingham¹ as sequelæ in unhealthy patients, especially if the healing has been accompanied by prolonged suppuration. The antiseptic surgery of the present day should prevent this.

ANAL FISSURE² OR ULCER

The operative treatment of this is so simple and so eminently successful, that it should be resorted to early.

The preparatory treatment and the position of the patient are the same as those already given.

A. The Division of the Ulcer. In early cases all that is necessary is to dilate the contracted sphincter thoroughly, thus dividing the base of the callous ulcer, under full ether anæsthesia, followed by local sedatives, rest in bed, and keeping the bowels open and the motions soft.

B. Excision and Suture. In chronic cases complete excision of the fissure is necessary. To hasten healing, and make it more certain, the whole ulcer, whose base and margins are often firm from long-continued chronic inflammation, is excised down to the muscle fibres, leaving healthy tissues, which are sewn carefully with a continuous catgut suture. Each stitch must run deep to the apex of the V-shaped wound, so that accurate apposition of the depth, as well as of the mucous edges, is obtained. If only the mucous edges are joined a fistula may result and time be lost instead of saved by sewing the wound. Any sentinel pile is also excised. It is always wise to examine a section of the edge or base of the fissure for early epithelioma.

¹ *Loc. supra cit.*, p. 163.

² This condition, often called a fissure, nearly always amounts to an ulcer when it is carefully examined and the parts unfolded. It is often formed by the tearing down of one of the pouches placed at the junction of the anus and rectum. The strip of mucous membrane which is torn down to the anal margin is often called the sentinel pile (Dall).

PROLAPSUS

Indications Failure of previous treatment Large size and long duration of the prolapsus Altered condition of the mucous membrane, viz thickening or ulceration, the latter giving rise to hæmorrhage In continence of fæces, especially when fluid, or of flatus It is very rare for any operation to be required in children for care in dieting, enforced rest in the horizontal position and proper attention to the bowels, nearly always suffice Threadworms, rectal polypi, phimosi, or vesical stone must be sought for and treated if necessary

OPERATIONS Linear Cauterisation—Excision—Plastic Operation to Restore Sphincter Ani—Sub-mucous Injection of Paraffin—Proctopexy—Colopexy.

The after treatment is that given below

(1) **Linear Cauterisation** This is only suitable for slight prolapse The position of the patient is as for pile operations, but it is best to apply the cautery to the bowel *in situ*, though this may be used when the bowel is prolapsed

Thus, the patient being in lithotomy position with a duckbill speculum introduced and held in contact with the anterior wall of the rectum, the blade of a thermo cautery is drawn edgeways along the lower three or four inches of the opposite surface of the gut The speculum being shifted, the anterior and lateral aspects are similarly treated in severe cases

Care must be taken not to go *through* the mucous membrane, or septic mischief and sloughing may be set up in the cellular tissue beneath

(2) **Excision** In severe cases in adults, when other methods have failed, this method should be resorted to Either portions of mucous membrane only or, in very severe and intractable cases, the whole prolapse may be removed

(1) **Excision of Mucous Membrane** The patient being in lithotomy position, the prolapsus reduced, and the parts exposed by a duckbill speculum, two or more longitudinal elliptical pieces of mucous membrane are clamped and removed, and the edges of the wound are united by a continuous catgut suture

The insertion of sutures has the advantage of preventing hæmorrhage and hastening the cure In some cases the prolapsed mucous membrane is excised much as in Whitehead's operation for hæmorrhoids

(11) **Complete Removal of the Prolapse** Although a more certain cure, this method is much more severe than those already described and, owing to the risk of the operation, should be reserved for cases in which other methods of treatment have failed, the prolapse has become irreducible, or when gangrene threatens

The operation essentially consists of amputation of the prolapsed bowel, with suture of the divided edges at the margin of the anus

It must be remembered, however, that a pouch of peritoneum may be present in front between the layers of the prolapsed bowel, and that, in certain cases, a herniated loop of intestine may lie within this pouch Owing to the vascularity of the parts, considerable hæmorrhage may occur, and, with a view to controlling this, several operators have advised constriction of the base of the prolapse, by means of clamps The objec

tion to this is, however, the possibility of damage to a knuckle of small intestine lying in a prolapsed peritoneal pouch. Moreover, the hæmorrhage may be satisfactorily dealt with by dividing only small portions of tissue at a time and immediately inserting mattress sutures close together.

The details of the operation have been varied by many surgeons, one of the best methods being undoubtedly that of Mikulicz, which is described as follows by Cumston, of Boston,¹ in a paper containing much valuable information :

"Mikulicz first cuts through the outer intestinal tube in its anterior circumference by cutting the tissues layer after layer, catching up each bleeding vessel as it appears, and ligating it with fine catgut. As soon as the peritoneal pouch has been opened, its interior is examined for the presence of small intestine. The peritoneal cavity is then closed by a running suture. The anterior aspect of the internal intestinal tube is cut through, little by little, until it is opened, and then both intestinal tubes are united by deep catgut sutures along the entire line of the incision.

"The posterior circumference of the prolapse is treated in absolutely the same way, both intestinal ends being united by means of sutures, and thus the resection is completed."

(3) **Plastic Operation to Restore the Sphincter Ani.** In some cases, when the anus is patulous or the sphincter paralysed or damaged, this may be performed, with the object of narrowing the orifice and, if possible, of restoring the function of a divided sphincter also. Thus Mayo Robson makes a semilunar incision parallel with the anterior margin of the anus. The wound is deepened for about half an inch and then sutured, so that it runs antero-posteriorly. This narrows the anal orifice very considerably and tightens the sphincter. The incision may be so placed that a divided, long or weak sphincter may be reconstructed. The wound is entirely external to the bowel, and in this respect this method is better than excision of wedges from the anal margin.

(4) **Sub-mucous Injection of Paraffin.** In some cases, with paralysed or lost sphincter, this may be found to be of value as in Stephen Paget's case² of prolapse following perineal excision of the rectum. A. H. Burgess³ described the technic and has used this method with success in many cases, but the need of it has diminished of late years, and some bad results have been reported, probably due to errors of technic leading to infection of the rectal walls.⁴ The method has a very limited use and requires great care in application.

(5) **Proctopexy.** Lockhart-Mummery⁵ makes a transverse incision, two and a half inches long, midway between the tip of the coccyx and the anus, opening up the space between the sacrum and the rectum and filling this space behind and at the side of the rectum with a large quantity of sterilised vaseline gauze which is left in for a week. At the end of this time it is changed and, at the end of another week, finally removed, when a tube is inserted to drain the wound. The sphincter ani is also restored

¹ *Ann. of Surg.*, 1900, xxxi, 311.

² *Brit. Med. Journ.*, 1903, i, 366.

³ *Lancet*, 1904, ii, 59, and 1921, i, 349 and 457.

⁴ *Lancet*, 1921, i, 406.

⁵ *Lancet*, 1921, i, 270.

by a plastic operation if necessary. Mummery claims twenty nine recoveries out of thirty two cases two of which needed two operations each.

(6) *Colopexy*¹ A long incision is made through the left rectus and the Trendelenburg position is adopted the small intestines raised and packed off and the pelvic colon drawn up thus reducing the prolapse completely. This is not always possible and in a case of this kind the writer was driven to resect the prolapsed part from the anus. The recto-vesical pouch in the male or the pouch of Douglas in the female is obliterated by catgut sutures passed between the serous coverings of the rectum and bladder or the uterus and vagina and left broad ligament. Then the pelvic colon is sutured to the left psoas and psoas parvus which have been exposed by incising the peritoneum covering their anterior surfaces. The outer edges of this peritoneal incision also are sewn to the outer border of the colon. When the operation is completed the bowel runs downwards, inwards and to the right along the left lateral wall of the pelvis.

After-Treatment After any operation for prolapse the patient must rest for three weeks to allow firm consolidation and cicatrization. Light diet only should be allowed at first and the motions should be kept soft by giving liquid paraffin in regular and sufficient quantities aided by an occasional oil enema.

IMPERFORATE ANUS IMPERFECT RECTUM

(Figs 420 to 426)

These rare * congenital malformations are much commoner in males.

A surgeon when called upon to explore these cases will do well to bear in mind the following natural and practical classification because on this depends his treatment.

Two Main Varieties A Cases in which no normal anus exists—**Imperforate Anus** B Cases in which a normal anus exists but the gut is obstructed higher up or undeveloped—**Imperforate Rectum**

A *Imperforate Anus* (1) Anus partially closed—(a) by adhesions of epithelial surfaces as occasionally happens in the labia of a female infant, (b) by a membrane (2) Anus completely closed but only by a membrane (3) Anus completely closed by a membrane but a fistula exists—(a) on the surface of the body (e.g. the raphe of the scrotum), (b) into the vagina (Fig 421) (c) into the urethra or bladder (Figs 422 426) (4) Anus imperforate and the rectum deficient as well.

B *Anus in Natural Position but the rectum is deficient*² (a) The rectum is deficient for a short distance only and separated from the anus by a partition (Fig 424), (b) the rectum is deficient for a long distance or entirely (Fig 425).

Treatment A Those in which no natural anus exists (1 and 2) If

¹ Lenormant *Beitr. Z. Klin. Chir.* 1906 and Quenn and Duval *Rev. de Chir.* February 10 1910.

² W. S. Q. inland (*Boston Med. and Surg. Jour.* December 1903 p. 870) quotes the figures of two lying in hospitals showing 31 cases in 70,000 infants.

³ As Mr. Holmes has shown, these cases are important as they are liable to be overlooked till considerable distension has taken place.

the atresia be due to epithelial adhesions, or to a more or less complete membrane, the former should be broken down and the latter snipped

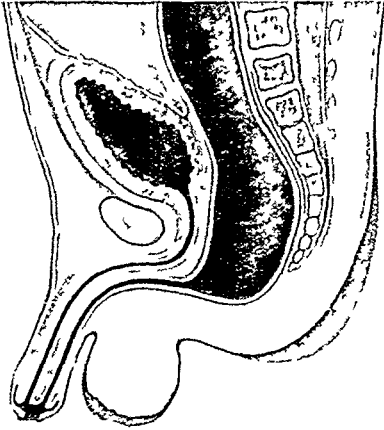


FIG 420¹ Anus absent, rectum opening by fistula, close to urethra.

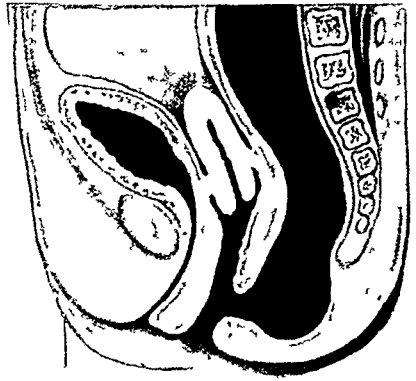


FIG 421. Anus absent, rectum communicating with vagina

away with scissors, and the opening kept patent, the nurse's little finger being introduced twice daily.

(3) If the anus be imperforate and the fistula open (a) on the surface of the body, (b) into the vagina, or (c) urethra.

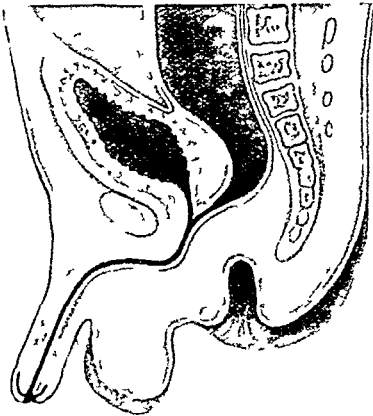


FIG 422. Anus ending in a cul-de-sac, rectum opening into urethra far back.

(a) A probe is passed from the skin-fistula (e.g. in the scrotum) towards the proper anal site; it is then cut down upon and the opening enlarged and established in the proper position.

(b) If the fistula open into the vagina, the treatment will vary somewhat with the urgency of the case, the size of the opening, and the age of the child. Thus if the opening be very small and the retention urgent, a silver director should be passed through the vaginal fistula back to the proper site of the anus, and there cut down upon. If the bowel is within reach, it should be drawn down and stitched *in situ*. The orifice should be kept patent.

In such a case, though an anus is established in the proper position, it is very doubtful if the vaginal fistula will close, and a further operation will probably be required later on. Plastic operations should not be tried too early, on account of the smallness of the parts, feebleness of the baby, the softness of the tissues and the liquid condition of the fæces.

¹ This and the next six figures have been redrawn from an article by Mr. Rushton Parker (*Liverpool Med. Chron.*, July, 1883).

If, owing to the size of the vaginal fistula, there be not much retention, and especially if the child be not very young, the following operation

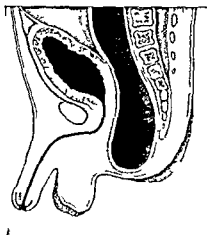


FIG 423 Anus absent Rectum could be reached by dissection

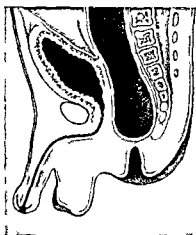


FIG 424 Anus ending in cul de sac Rectum readily reached from the s

may be performed after the method of Rizzoli quoted by Mr Holmes¹ An incision is made from the vulva to the coccyx in the middle line the rectum found by most careful dissection separated from the vagina

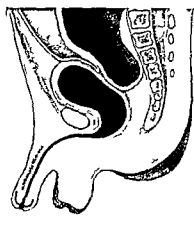


FIG 425 Anus absent rectum ending high up A case for Littre's operation

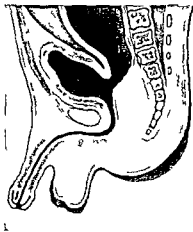


FIG 426 Anus and rectum deficient the bowel ending in the bladder

and then brought down and fixed in its natural position To aid in finding the rectum a probe should be passed from the fistula

After the rectum has been brought down and secured the incision between the anus and vulva is united to form a new perineum

(c) *Fistula into the urethra or bladder* Two questions here arise

¹ *Syst of Surg* iii 788

How high up is the communication? How much of the bowel is deficient?

If the perineum seems fairly developed, if the ischial tuberosities are not in close contact, if any bulging can be detected at the natural site of the anus, the communication is probably recto-urethral, and an attempt may reasonably be made to find the bowel from the perineum. If it is found, and can be brought down, an attempt should be made to separate it from the adjacent urethra, but sometimes the surgeon will have to be satisfied with a free opening, and with keeping this patent. The fistula can be closed later by a perineal plastic operation. If there appear no probability of the bowel being within reach, or if this cannot be found, left inguinal colostomy should be performed. If the child survive, the bladder must be kept carefully washed out if any fæces still find their way into it. Thus, in a case of Mr. Clutton's¹ a child about a month old died, sixteen days after Littre's operation, of suppurating kidneys, due to the offensive purulent urine.

(4) Anus absent and rectum deficient as well. Here the chief question is how far upwards an exploratory operation may be safely conducted.

External evidence. Genitals far back and close to the coccyx, and ischial tuberosities close together, point to absence of the rectum.

In most cases the surgeon begins by exploring. The child being anæsthetised and in lithotomy position, a small sandbag is placed under the sacrum, and the bladder emptied with a catheter; the surgeon, seated at a comfortable level, makes a free incision from the position of the anus back to the coccyx. Keeping exactly in the middle line, and opening up the cellular tissue with his finger-tip, aided by a scalpel and director, he works backwards towards the concavity of the sacrum, constantly taking note with his finger-tip of the depth to which he has got, while an assistant aids in bringing down the bowel by suprapubic pressure.

As a rule, two inches are of sufficient depth in a new-born child. If still in doubt whether to proceed or not, the surgeon may make a careful puncture with an exploring syringe backwards and upwards.

Points to bear in mind. (1) The rectum may end at the brim of the pelvis. (2) If it end lower down, it may be floating with a long mesorectum. (3) Though the rectum may end within reach, the peritoneum may, and not infrequently does, extend low down on the bowel. (4) Even if the rectum is successfully opened high up without opening the peritoneum, fatal cellulitis may be set up by the escaping fæces, or by the attempts to keep the bowel patent.

If the above exploratory operation fail, inguinal colostomy should be performed.

B. Imperforate Rectum. The treatment here will be an exploratory perineal operation, followed, in case of failure, by colostomy (p. 273), but in some cases the colon may be found empty or represented only by a fibrous cord. In such cases the small intestine must be drained as low down as possible.

EXCISION OF THE RECTUM

The rectum extends only from the middle of the third piece of the sacrum, where the pelvic colon ends, to the insertion of the levatores ani

¹ *St. Thomas's Hospital Reports*, xi, 84.

at the upper end of the anal canal. It is from five to six inches long and the slit like anal canal is from one to an inch and a half long. The rectum has no mesentery, and only its upper half is covered by the peritoneum in front. Near the upper end the serous membrane extends to either side of the bowel. Its blood supply is derived from five arteries—the superior hæmorrhoidal, two middle and two inferior hæmorrhoidals. Of these the first is by far the most important and indispensable for it supplies nearly the whole rectum, the other vessels only helping to supply the very lower part. The veins of the rectum are similar to the arteries, the greater part of the blood returning by means of the superior hæmorrhoidal and inferior mesenteric to the portal vein. The lymphatic drainage of the rectum is of the greatest importance. P. P. Cole¹ divides its lymphatic network into (1) the Submucous, (2) the Subserous, (3) the Intermuscular and Intramuscular. The important intermuscular lymph vessels are arranged in a circular manner and this may account for the well known tendency of carcinomatous growths to encircle the bowel. Cole thinks the spread of carcinoma from the submucous network is along vessels which radiate like the spokes of a wheel and terminate in the intermuscular plexus. From these larger vessels run out into the subserous plexus and the lymphatic trunks and glands behind the rectum. Cole in twenty cases did not find any evidence of extensive permeation along the mucous and submucous coats. The lymphatic vessels traverse the pararectal glands and extend upwards behind the rectum to the glands in the pelvic mesocolon and those on the vessels near the left sacro-iliac joint. These drain into the aortic glands, especially about the inferior mesenteric artery. In striking contrast with this the lymphatic drainage of the anus and anal canal is chiefly downwards and forwards into the inguinal glands and also partly along the inferior and middle hæmorrhoidal vessels to the internal iliac glands.

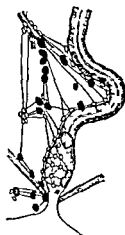


FIG. 42.—Showing the various positions in which metastatic deposits and post-operative recurrent growths have been found to occur. It will be seen that the rich rectal fat, the levatores ani and the pelvic mesocolon (particularly the parietal border) are exceedingly dangerous tissues. (W. F. Miles.)

Nearly all malignant growths of the rectum are carcinomata, whereas those of the anal canal are squamous epitheliomata with an occasional melanoma. Growths of the rectum spread along the lymphatics in the wall of the bowel both upwards and downwards but especially upwards and chiefly along the subserous plexus according to Cole². Handley, with the mucicarmune stain has found what he regards as degenerating cancer cells in the mucosa extending at least six inches above the primary growth when there has been no change in the naked eye appearances and he has attributed these to permeation along the lymphatic network of the mucous membrane. Most observers supported by clinical experience believe such an extensive spread to be very rare, and Cole asserts

¹ Brit Med Journ 1913 i, 431

² Brit Med Journ 1910 i, 748

that when it occurs the spread is through the subserous plexus and lymph trunks behind the bowel. To a lesser degree extension occurs downwards towards the ischio-rectal fossa and anus, and occasionally the inguinal glands may be infected. Growths of the rectum also extend laterally into the connective tissues around the rectum and into the neighbouring viscera, such as the prostate, vagina, bladder and uterus, and also invade the sacrum in late cases. The most important line of spread, however, is along the lymphatics into the glands behind the rectum and in the pelvic mesocolon. Cole found that the growth had extended into the lymphatic vessels behind the rectum in every one of his twenty cases. But cancer of the rectum is usually slow to spread to the lymphatic glands or to disseminate into the liver or other viscera. J. R. McVay,¹ who carefully examined 100 specimens of carcinoma of the rectum removed at the Mayo Clinic, found no evidence of glandular involvement in 53 per cent., but these examinations did not necessarily exclude the possibility of infection of glands or tissues still left in the body.

The pelvic peritoneum is often affected, and in some cases a widespread infection takes place through the peritoneum. The ovaries may become infected. In some cases embolic infection of the liver occurs, but as a rule this is a late event. It is difficult or impossible to separate growths of the lower part of the pelvic colon from those of the rectum. Indeed, it is common to find growths at the junction of the rectum and pelvic colon. Therefore, growths of the lower end of the pelvic colon will be considered with those of the rectum.

Indications. Apart from malignant disease it is very rarely necessary or wise to attempt excision of the rectum. Professor H. Hartmann² advocated this operation for certain cases of severe simple tubular stricture of the rectum. He performs the perineal excision with preservation of the sphincter ani. He reported thirty-four operations with only two deaths, from pelvic cellulitis. Carcinoma of the rectum is mostly slow growing and long remains localised to the pelvis, but the lymphatics and connective tissues behind and at the side of the rectum are ultimately invaded by minute collections of cancer cells too small to be appreciated except with the microscope. These and the lymphatic glands in the pelvic mesocolon can be removed in one mass with the primary growth in the bowel. Similarly extensions of growth up and down the bowel, within the fibrous sheath of the rectum, can be overcome by wide resection. Therefore, *removability depends chiefly on the amount of mobility of the growth and the probability of freedom from invasion of important local structures*, such as the bladder, prostate, urethra or ureters. It is a melancholy fact that a very large proportion (at least 40 per cent.) of growths of the rectum when the patients first come to the surgeon are inoperable usually on account of large size and invasion of important structures in the pelvis. In most of these cases a timely and routine examination of the rectum with the finger whenever abdominal or pelvic symptoms are present should have led to earlier diagnosis. It is important to remember that a high growth often becomes palpable when the patient is in the sitting-up position and straining, and counter-pressure is made above the pubes. In some high growths, and especially those of the pelvic

¹ *Ann. of Surg.*, 1922, lxxvi, 755.

² *Trans. Med. Soc. Lond.*, 1923, xlv, 194.

colon, the sigmoidoscope is necessary and should be used when there is any suspicion. It is not always easy to estimate the amount of local extension. The proctoscope is often of value in deciding on the mobility of growths which are too high for thorough examination with the finger. In many cases an anæsthetic is necessary. The part where it is most difficult to estimate the mobility is in front in the neighbourhood of the bladder, prostate and urethra. As regards the bladder mere adhesions of the growth to it is not a bar to resection for portions of the peritoneal and muscular coats may be safely removed but if the mucous membrane is involved it is not wise to attempt an operation, for the invasion is generally at the base of the bladder, and a satisfactory control of the latter is difficult to obtain under these circumstances. The extent of this invasion can be best judged by means of the cystoscope which should be used when there is any doubt. When a recto vesical fistula has formed it is obviously too late for a radical operation. Invasion of the prostate is not so grave, for the greater part of this gland can be removed with the growth. Invasion of the urethra is more serious and is shown by difficulties in micturition and in passing a catheter. The left ureter has to be very carefully separated from the growth in some cases.

Invasion of the vagina or uterus although serious is not a bar to operation, for these structures can be removed together with the growth in the rectum. Invasion of the ovaries is more serious for it generally means that cancer cells have been discharged into the peritoneum and a widespread but less obvious infection of other viscera may have taken place. Sometimes evidence of peritoneal infection can be found in the form of a hard shelf of deposit at the bottom of the recto vesical or utero-vesical pouch, and this can be felt on pelvic examination. This is an absolute bar to resection. The liver should be very carefully examined in all cases, for in some the pelvic growth may be freely movable and yet the liver be affected. With the abdominal wall well relaxed the thighs flexed and the patient taking deep inspirations the edge of the liver may be noticed to be hard and irregular or nodules may be felt on its anterior surface. Sometimes these growths may not be feelable until the patient is under an anæsthetic, and unfortunately a multitude of minute growths in the liver may not be palpable until the abdomen is opened. In the majority of cases full information is not obtained as to the operability of the growth until the abdomen has been explored and this should be the first step in the operation. The hand is first passed above both lobes of the liver, for here early embolic growths are most commonly felt. Next the hand is swept down along the aortic glands. If these are hard and considerably enlarged resection of the primary growth is rarely indicated, except perhaps as a means of giving greater comfort than colostomy or leaving alone. Similarly the iliac glands are felt and then the mobility and connections of the primary growth are carefully examined. Often a growth, which from below seems to be fixed proves to be fairly movable when it is examined from above. Above all the age and condition of the patient are to be carefully considered for resection of the rectum is a serious operation, which cannot be borne by very old or very feeble patients. Age is, of course, not to be judged by years alone, but by the condition of the viscera and the general vigour of the patient but it is rarely wise to attempt an extensive resection after 70. Anæmic or

cachectic patients do not stand these operations well, and in very stout patients the mechanical difficulties of a combined abdominal and perineal operation are very considerable. A man of this type is far more difficult to deal with than a woman on account of the smaller space available in the pelvis, and the greater proximity of the male bladder, ureters and urethra to the growth. In some of these bad subjects a perineal resection may be well borne, when a combined operation would be very risky. In these cases the advantages of an abdominal exploration and preliminary colostomy are great. Arterio-sclerosis with high blood-pressure, nephritis and diabetes are serious contra-indications.

Whenever possible without undue risk excision of the rectum should be chosen in preference to colostomy for, although the mortality of excision is much greater than that of colostomy, the average duration of life after it and the amount of comfort given by it when well performed are much greater. Preliminary treatment by radium, X-rays or injections of colossal preparations of metals are of little if any value; they waste time and may interfere with healing after operation.

CHOICE OF OPERATION

When considering the choice of operation it is wise to bear in mind certain principles which are of great importance.

(1) All the tissues which are reasonably likely to be diseased must be removed *en masse* with the primary growth. At least four inches of the bowel above and two inches below must be removed together with the lymphatic vessels and loose connective tissues behind and at the sides of the rectum. The lymphatic glands high up in the pelvic mesocolon also must be removed, a clean sweep being made of all the soft parts in front of the sacrum. This is not easily done by any perineal or sacral operation.

(2) Asepsis must be maintained, for nearly all deaths after excision of the rectum are due to sepsis in one form or another. Therefore, the lower bowel must be well cleared out for several days before the operation or, when this is impossible, a preliminary colostomy must be performed. For the same reason great care must be taken to avoid opening or dividing the bowel in the pelvis during the operation except when absolutely necessary, and then the stumps should be sterilised with the thermo-cautery. With the same object the anus is sutured or tied at the beginning of the operation.

(3) The preservation of the blood-supply of the parts to be joined is of the greatest importance, and with this object a careful study of the blood-supply of the rectum has been made by Sudeck,¹ Hartmann, and Davis.² Nearly all the blood-supply of the rectum is derived from the superior hæmorrhoidal artery. This divides into two main branches as it descends in the pelvic mesocolon. These branches run down on either side of the back of the rectum to within five inches of the anus. Here they divide into about six branches which pierce the muscular coat of the rectum and run down in the submucous tissues as far as the anus, in their course anastomosing with the middle and inferior hæmorrhoidal arteries above the p.p.

¹ *Munich. Med. Woch.*, 1907, liv, 1314.

² *Ann. of Surg.*, 1910, lii, 529.

on either side, which, however, are not to be relied upon to nourish more than the very lower end of the rectum and the anal canal. Complete excision of the rectum with its lymphatics and glands is impossible without high division of the superior hæmorrhoidal artery. The lower part of the pelvic colon and the upper end of the rectum are supplied from the lower sigmoid artery and an anastomotic loop which runs down generally close behind the bowel from this to the superior hæmorrhoidal or sometimes to the posterior or right branch of the latter (see Fig. 428). Sometimes the lower part of this loop is mistakenly called the lower sigmoid artery. It is clear that the best place to tie and divide the superior hæmorrhoidal

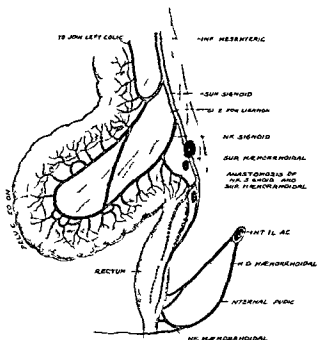


FIG. 428 The arterial supply of the pelvic colon and rectum

artery is about an inch below the origin of the upper sigmoid artery for in this way the valuable anastomosis between the sigmoid arteries and the blood supply of the pelvic colon are maintained when the pelvic loop is mobilised and straightened out. Unfortunately it is almost impossible to tie the main artery at this point of election by any perineal or sacral operation nor is it possible to identify the vessels with accuracy.

(4) Restoration of Function. Whenever possible without sacrificing the other principles we should endeavour to restore the natural function and an early diagnosis and operation make it possible to do this in selected cases.

Careful study of the pathology of carcinoma of the rectum shows that for a good hope of radical cure it is necessary to remove the whole of the rectum together with its lymphatics and glands in the pelvic meso-colon. No perineal or sacral operation allows the satisfactory removal of

this extensive area without endangering the blood-supply of the bowel to be brought down either to the anus or to the sacral region. A free view from the abdomen is necessary for the proper examination of the vessels, so that the latter can be tied at the most advantageous spot. Above all, a complete removal of infected glands is far more certain and easy from above. Further, an abdominal exploration is the only certain way of finding out the operability of the growth and proving the absence of disease in the liver, peritoneum and aortic glands. Therefore it is clear that some form of combined abdominal and perineal excision is the ideal from the pathological point of view, and this should be done in the majority of cases which are suitable for excision, for local recurrence is far too common after perineal and sacral resection. In many doubtful cases the abdominal exploration will prove in a few minutes that resection is either impracticable on account of invasion of important structures, or inadvisable on account of secondary nodules in the liver, a condition which the writer has found more often than he expected with a movable primary growth. It is not so easy to decide which type of combined operation to adopt in any given case. There is no advantage in combining the abdominal and sacral routes unless the growth is adherent to the sacrum or coccyx, and these cases are generally too late. Otherwise sacral completion of the operation is more dangerous, tedious and hæmorrhagic than the perineal. For these reasons I do not think it worth while retaining the description of this operation. The difficulty is in deciding between (1) *the abdominal*, (2) *the abdomino-perineal*, and (3) *the perineal* methods.

(1) When a growth at or near the junction of the pelvic colon and rectum, together with the glands and lymphatics in the pelvic mesocolon, can be widely removed, end-to-end union may be made by direct suture with the aid of the tube method. When this is practicable much time is saved and perfect function is restored, for the structures of the pelvic floor are not disturbed. This operation is particularly applicable to old and feeble patients who are not likely to survive the more radical abdomino-perineal operation. Moreover, they are saved the annoyance and inconvenience of a colostomy.

(2) With the abdomino-perineal method a permanent inguinal colostomy is adopted and is regarded as the price paid for a greater chance of immunity from recurrence. It is applicable to all removable growths of any part of the rectum and anus, but it is a severe operation carrying a high mortality; therefore the much safer perineal operation is chosen for some growths of the lower part of the rectum and anus, especially in the old and feeble.

(3) There is a great advantage in preserving the pelvic floor and the sphincters in suitable cases, but it is not safe to do this when the growth is so low down or so late as to risk the probability of carcinomatous infection of the pelvic floor. There is no reason why the removal of the glands and bowel above and below the growth should not be as extensive as by the abdomino-perineal method, and then the lower end of a well-nourished colon can be brought to the anus after *free mobilisation of the descending colon*. But the abdomino-anal operation is clearly unsuitable for low, extensive, rapidly growing or late growths, for an attempt to save the pelvic floor and sphincters in them would almost certainly lead to local

recurrence With a proper selection of cases and free removal of the cellular tissues and glands in front of the sacrum local recurrence ought to be rare after the abdomino anal operation. One of the writer's patients survived for over thirteen years and died without recurrence. Should it occur and obstruction develop secondary colostomy can be performed. The abdomino perineal is clearly to be chosen when there is a probability of invasion of the pelvic floor and also for those very malignant growths which sometimes come in young people and grow and spread with great rapidity. So far the mortality of the combined operations in old and feeble patients has been too great therefore in most patients over 65 with growth in the middle or lower part of the rectum the improved perineal method should be chosen for this carries less risk and yet gives a fair chance of freedom from recurrence and relief from symptoms. The abdomen should be explored to ascertain the condition of the liver glands extent and mobility of the growth in the pelvis and to perform preliminary colostomy. This can be done through an opening near the middle line only large enough to admit a hand. Epithelioma or melanoma of the anus is best removed widely by the perineal operation of Lockhart Mummery the glands in the groin being removed later.

PRELIMINARY COLOSTOMY OR CÆCOSTOMY BEFORE EXCISION OF THE RECTUM

Theoretically this preliminary step which is essential in cases of complete obstruction would seem very desirable in other cases especially if the infective fæces are completely diverted so as to lessen the chances of infection during the severe operations in the pelvis. Cæcostomy under local anaesthesia serves well in many cases. Kraske Quénu Keen Hartwell Mayo Lockhart Mummery and many others are in favour of preliminary colostomy. A colostomy opening in the left groin makes abdominal or combined resection more difficult and less clean but a very high iliac colostomy or one in the transverse colon may overcome this difficulty. Preliminary colostomy adds considerably to the duration of the patient's illness for the resection is not wisely undertaken less than ten days after the colostomy and the closing of the fistula later on if desirable may take an indefinite time. Several anaesthetics may have to be taken but the colostomy may be done under local anaesthesia. The combined mortalities of complete preliminary colostomy and resection are lower than that of resection without preliminary colostomy, and there is no doubt that preliminary colostomy and two stage operations have done much to reduce the mortality of this severe operation. At the time the colostomy is performed it is wise if possible to examine the liver and glands to find out if resection of the rectum can be done later.

In some cases colostomy improves the general health so much and diminishes the inflammation and fixation of the growth so markedly that a resection may be successfully carried out in cases which at first appeared to be too late.

It would seem therefore that preliminary colostomy is either necessary or wise for (1) those cases in which there is either declared or threatened obstruction preventing the proper evacuation of the bowel before the growth is excised in many of these temporary cæcostomy suffices

(ii) Cases in which it is fairly certain that it will never be possible to secure a controllable anus in the natural position. An inguinal artificial anus is preferable and more under the control of the patient, and is far better than a long fibrous stricture or the ulcerating track, devoid of any control which so often followed the old unsatisfactory perineal excision. I have seen patients whose lives have been very miserable under these conditions, and who have been greatly relieved by a secondary colostomy. In some cases the colostomy is made at the same time as the resection, and in others colostomy is avoided by the use of the long rectal tube to drain the colon.

The following methods will be described :

- (1) **Local Excision of the Growth.**
- (2) **Perineal Resection of the Rectum.**
 - (a) *Lockhart-Mummery's Method.*
 - (b) *The Quénu-Tuttle Method* (for non-malignant disease).
- (3) **Abdomino-Perineal Excision.**
- (4) **Abdomino-Anal Excision with restoration of the Natural Anus.**
- (5) **Abdominal Resection.**

(1) **Local Excision** of the growth with only a part of the circumference of the bowel should be reserved for villous papilloma or adenoma and for the rare cases of carcinoma where the disease is discovered early and is very small and superficial, admitting of extirpation together with a wide margin. Mayo reports five such cases with freedom from recurrence, and the writer removed a papillary carcinoma from the rectum of a feeble old lady who had no sign of recurrence five years later. Such an operation may be justified in a very old or feeble patient, who is utterly unsuitable for a radical operation. In such a patient a growth which forms the presenting part of an intussusception, or a growth limited to one aspect of the rectum, may be capable of withdrawal through the dilated anus. In such cases, which are early ones with unusual mobility and freedom from invasion of neighbouring tissues, the intussuscepted mass can be resected, and the remaining healthy ends joined together after Maunsell's method, but the lymphatic glands cannot be removed. The late Mr. Allingham thus condemned partial operations: "The partial removal of the circumference of the bowel is, in my opinion, most unsatisfactory. In all the cases in which I have removed only part of the wall there has been either a return of the disease in the rectum or in the glands in the groin, or in some internal organ, mostly the liver."

(2) **Perineal Resection of the Rectum.** (a) **Mr. Lockhart-Mummery's Operation.** Mr. Lockhart-Mummery kindly sent me the following account of his operation: "The operation is better performed in two stages, but this is not essential unless the patient is old or unless some degree of obstruction is present. The first operation consists of a colostomy performed through the left rectus muscle fairly high up. This is done under gas and oxygen and local anæsthesia. At the same time the opportunity is taken for examining the abdomen, liver and upper relations of the growth, etc. The colostomy is opened two days later, and the lower bowel and rectum are then washed out daily from the lower colostomy opening.

The second operation is performed ten days later. The patient is not starved beforehand—he is only deprived of breakfast on the morning of the operation. Heroin or morphia and atropine are given about three quarters of an hour before operation unless twilight sleep is being used when scopolamin and morphia are substituted. Spinal anæsthesia is used combined with either gas and oxygen or twilight sleep. Ether and chloroform are never used.

The operation is performed in the left semi prone position. Before beginning the operation a No. 8 gum elastic catheter is tied into the bladder if the patient is a man in order to act as a guide to the urethra.

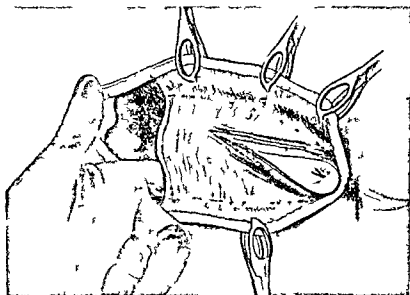


FIG. 479. Perineal excision of the rectum. Lockhart Mummery's operation. Showing the method of dividing the fascia and levator ani muscle where it is reflected from the pelvic wall on to the rectum. The first finger is passed deep to the muscle and the division made with scissors along the dotted line. The lower muscle being cut first. Previous to this the fascia is cut through transversely as shown. (Lockhart Mummery.)

during the operation. This is not necessary in women, but the vagina should be thoroughly aseptised by swabbing it out with iodine or by packing with brilliant green two hours previous to operation. The first step in the operation is to pass a stout silk ligature round the anus subcutaneously with a curved needle. This is easily and quickly done by entering the needle in front and bringing it out behind the anus, then re-entering it at the same spot and bringing it out again where it first entered. This is tied up tightly so as to exclude the anus entirely. After this the skin all round is thoroughly painted with iodine and the towels are put in place. The surgeon does not wash up or put on his gloves until after he has closed the anus. The incision is made starting from the base of the sacrum and carried forwards in the midline surrounding the anus and well clear of it to meet about one and a half inches in front. This incision is then deepened, cutting well away from the rectum.

into the fat of the ischio-rectal fossæ. In a difficult case extra room can be obtained by making a transverse incision about three inches in length across the perineum at the front end of the wound. The coccyx is disarticulated, or, in case this should not give room enough, some of the sacrum is removed. The best method of disarticulating the coccyx is, after exposing it, to bend it forwards with the left thumb, and then with a knife it can be quite easily and rapidly detached from the sacrum. The deep fascia is opened just in front of the sacrum, and the first finger of the left hand is passed deep to the left levator ani muscle and between this muscle and the rectum (Fig. 429), and the levator ani cut well away from the rectum with scissors. The same is then done on the right side. The

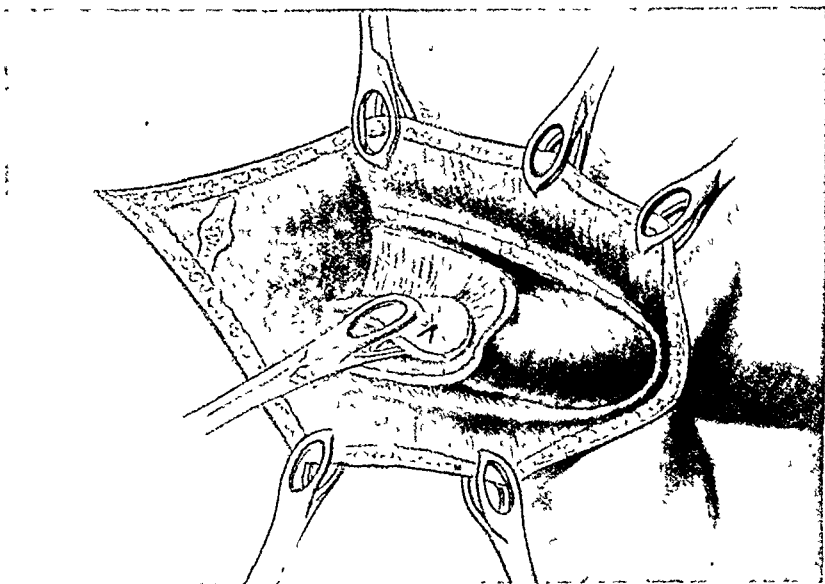


FIG. 430. Perineal excision of the rectum. The rectum is being freed in front from the urethra and prostate. This division is made with blunt-pointed scissors, guided by a catheter in the urethra. When the prostate is reached, the rectum can be stripped quite easily until the peritoneum is found. (Lockhart-Mummery.)

next step is to dissect the rectum away from the prostate or vagina in front. This is easy in the female, but rather difficult in the male. The catheter tied into the urethra is a useful help, as it can be felt through the wound and prevents one getting in front of the prostate (*see* Fig. 430). This part of the dissection must be done boldly with scissors, care being taken not to injure the rectum, as this would involve a septic wound. After the wound in front of the anus has been deepened about two to three inches, the lower edge of the prostate will be reached and the rectum will strip easily. The peritoneum will now come into view, and should be opened and cut back along the sides of the rectum and close to it. The rectum and growth are now free except above. The mesorectum is next cut through as high up and as far back as possible, and the vessels in it caught with forceps and tied off. Only the bowel now remains to be divided. This is done between two clamps with a Paquelin cautery (*see* Fig. 431). The stump of the sigmoid in the upper clamp is now invaginated

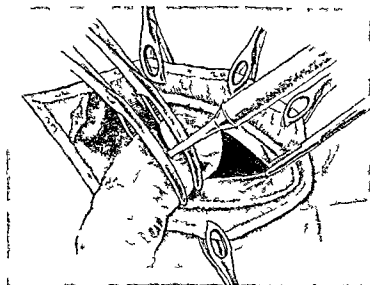


FIG 431 Perineal excision of the rectum. The rectum has been freed and the peritoneal cavity opened. The mesorectum has been tied off. Two clamps have been applied to the mesorectum and the bowel is being held between them with a cautery. The peritoneal cavity is shown open. In reality two will be packed off with gauze tampons and would the whole wound. (Lockhart Mummery)

by a catgut Mickulicz stitch and further protected by mattress or purse string stitches over this. The peritoneum is next closed by a continuous catgut stitch on a small curved needle. This should start on the lower side next to the bowel and be carried round to the opposite side the

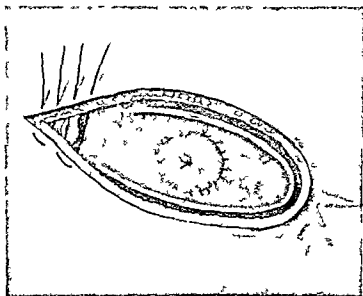


FIG 43 Perineal excision of the rectum. The completion of the operation. The end of the bowel has been closed and invaginated and the peritoneum sewn up. The skin wound is being closed with mattress stitches. (Lockhart-Mummery)

stitches taking up the peritoneum and recto-vesical fascia on one side, and the peritoneum and elastic coat of the bowel stump on the other. The turned in end of the bowel should be left on the wound side of the pelvic diaphragm. The wound is then closed without drainage (Fig. 432) or with a small sheet rubber cigarette drain only.

"The operation has sometimes been performed in thirty-five minutes, and unless special difficulties are encountered it should not take more than forty-five minutes. If in a female the posterior vaginal wall is involved, it may be removed together with the rectum.

"**After-Treatment.** The patient is generally out of bed in fourteen days, and usually able to return home in three or four weeks. There is one factor in the after-treatment which is a departure from common practice—namely, that ordinary solid food is given from the start. No alteration in the patient's usual diet is made, and he is given an ordinary meal as soon as he wants it. To ensure asepsis of the wound the dressings are changed twice daily. Blood-clot necessarily collects in the cavity left by the removal of the rectum, and the day after operation a pair of sterilised dressing forceps should be passed between two of the stitches to allow this to run out. This can be repeated when necessary, and if a mild infection occurs a drainage tube can be put in later.

"Great care must be taken with the bladder, as patients are very likely to get retention with overflow after this operation. In men I generally keep a catheter tied in for three or four days, and women are catheterised regularly every eight hours for the first few days.

"**Special Points in performing the Operation.** (1) A good light which can be directed into the wound is very important.

"(2) In performing the anterior dissection the surgeon must keep as close as possible to the posterior vaginal wall in women, and to the urethra and prostate in men. It is for this reason it is so important to have a hard catheter tied into the bladder.

"(3) The peritoneum should be opened as soon as reached and divided close to the rectal wall, and this will prevent any risk of damage to the ureters.

"(4) The mesorectum and its vessels should be divided as high up as possible, and the vessels all tied off before the bowel itself is divided.

"(5) In stitching up the peritoneal floor, it is very important to make certain that no gap is left through which a hernia could come down. If there is any doubt about being able to do this, it is better to pack the cavity and not attempt to close the peritoneal floor, as there is nothing so dangerous as a small gap left in the new peritoneal floor, and there have been a number of cases of strangulated hernia resulting from failure to observe this precaution.

"**Results of Operation.** The mortality from the operation in private practice from my most recent series of cases shows eighty-three cases with four deaths, an operative mortality of 4.8 per cent. Of these one was a lady of 62 who died from heart failure some days after operation and another an old lady of 75 years of age who died three weeks after operation. Hospital cases show a slightly higher mortality, about 8 per cent., which is probably due to their not being in such good condition, but this has been considerably improved since it was made a rule to keep the hospital cases in for a week or two before operation.

'As regards the recurrence figures taking a five-year standard the years 1915-1919 give the following result

Number of cases operated upon (including hospital cases)	73
Recurrences within five years	32
Died of other causes	7
Untraceable	4
Alive five years later	30

This table shows a percentage of 41 per cent alive five years after operation but the actual recurrence figures would be just over 50 per cent

(b) The Quénu-Tuttle¹

Method This is suitable only for non malignant disease such as intractable tubular stricture of the rectum

The patient is anaesthetised and placed in the lithotomy position with the pelvis slightly raised. The rectum is cleansed, dried and loosely packed with gauze so that its wall may be easily recognised and avoided during the later stages of the operation. The vagina is also washed out and the bladder emptied. An incision is made close to and around the anus and the mucous membrane of the anal canal is dissected up for about half an inch where it is firmly tied by means of a strong silk ligature and the end of the stump is sterilised with the cautery. The ends of the elliptical incision are then continued backwards as far as the tip of the coccyx and forwards into the perineum nearly as far as the scrotum. The fibres of the external sphincter are separated and divided exactly in the middle line anteriorly and posteriorly and drawn aside with the skin (Fig 433)

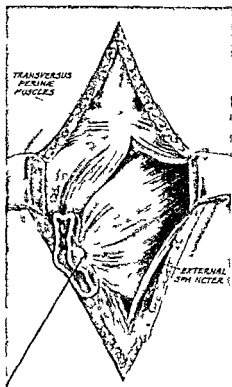


FIG 433 Perineal excision of the rectum for non malignant disease. The external sphincter and the levatores ani are saved (After Tuttle)

The posterior wound is deepened and the rectum is freed upon its posterior and lateral aspects the levator ani being divided close to the rectum (Fig 434). The anterior fibres are divided last after being isolated by passing the finger forwards and upwards close to the rectum. By blunt dissection the rectum is then freed from the sacrum and from the loose pelvic cellular tissues upon its lateral aspect.

¹ Tuttle *Diseases of the Rectum and Colon* 1903

The separation of the bowel in front varies with the sex of the patient. In a male, a full-sized metal sound having been passed into the bladder and kept well hooked up under the pubes, the surgeon carefully dissects, partly with his finger and partly with scissors, between the bowel and urethra and prostate. These parts are naturally adherent, and this dissection must be carefully conducted, as any opening into the bladder or urethra or injury of the ureters is a serious matter. As it is freed the bowel is drawn backwards and downwards so as to afford a good view

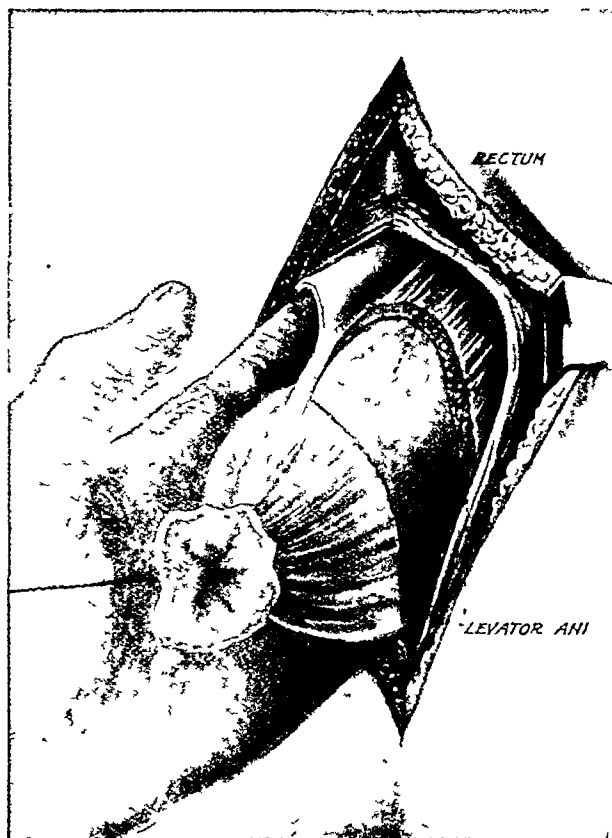


FIG 434 Perineal excision of the rectum for non-malignant disease. Division of the levatores ani near the rectum. (After Tuttle.)

of the depth of the wound (Fig. 435); disarticulation of the coccyx, which is then folded backwards, facilitates this procedure.

In the case of a woman the surgeon's left index, or the finger of an assistant in the vagina, will give the best warning of his knife or scissors (the latter, long and blunt-pointed, are preferable) getting too near the vaginal mucous membrane.

On continuing the dissection upwards the peritoneal pouch in front of the rectum is displayed. In some cases, when the stricture does not extend beyond this pouch, it is possible to avoid opening the peritoneum by displacing it upwards by blunt dissection. In the majority of cases, however, it is best to open the peritoneum at its lowest point (Fig. 436), and then to continue the incision to either side close to the rectum until

the mesorectum is reached. This is divided close to the sacrum so that it can be drawn downwards with the bowel. This avoids the risk of dividing the superior hæmorrhoidal artery at this stage in the depth of the wound.

The small intestines are packed away with gauze which also serves to collect any blood which tends to gravitate towards the abdomen when the pelvis is elevated. The rectum is separated freely enough to allow it to be drawn well out of the wound and the bowel above the disease

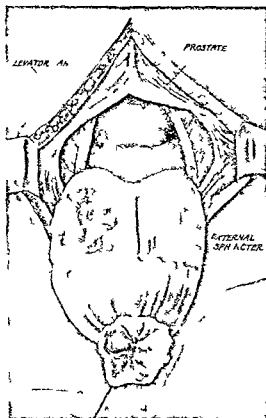


FIG. 435. Perineal excision of the rectum. The pelvic peritoneum and the prostatic sheath are displayed. (After Tuttle)

to be brought down and sutured without tension to the anal skin. The superior hæmorrhoidal artery is tied and divided. The parietal peritoneum is then sutured to the serous covering of the rectum with the double object of closing the peritoneal cavity as far as possible and lessening the tendency to retraction. Next the edges of the levator ani are sewn together and to the side of the rectum; this serves to reconstitute the pelvic floor to limit retraction and do away with the dead space which otherwise tends to fill with blood or serum and to get infected.

The bowel is drawn down and clamped above the disease with long curved intestinal forceps, the handles of which are below or behind. These prevent any leakage, retraction or hæmorrhage during the next stage. The rectum is cut across one third of an inch below the forceps

and at least two inches above the disease. The margin is then accurately joined to the anal skin, with numerous interrupted silk sutures, which pierce all the coats of the rectum and secure a good hold.

The anterior and posterior wounds are closed near the rectum by sutures which pass deeply and bring the divided ends of the external sphincter together. The wound is drained, and a tube is passed into the rectum (Fig. 437).

(3) **The Abdomino-Perineal Operation.** Mr. Miles,¹ from a careful

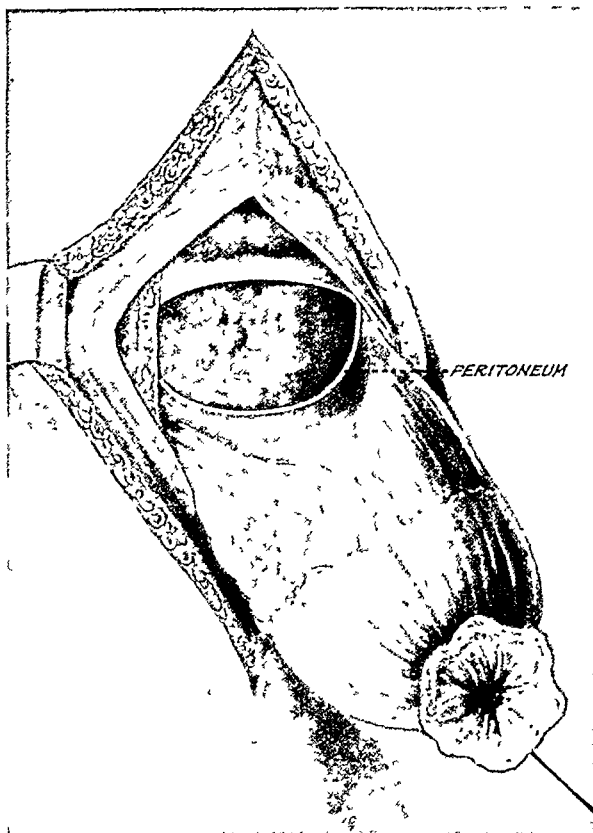


FIG. 436. Perineal excision of the rectum. The peritoneal pouch has been opened. (After Tuttle.)

study of the spread and recurrence of carcinoma of the rectum, concluded "that the most complete and extensive perineal (including sacral) operation possible is with few exceptions quite inadequate for preventing recurrence of the disease." Up to the end of 1906 he had performed 59 perineal excisions with only one death, but 54 of these had recurrence. Therefore he decided to abandon all perineal methods of excision and designed the abdomino-perineal operation, which he has gradually improved. He has kindly allowed me to use and vary his figures.

(a) *Abdominal Part.*—Spinal anæsthesia with twilight sleep and gas and oxygen greatly reduce the mortality of this operation. Before the war Mr. Miles had a mortality of 36 per cent. in 63 operations under

¹ *Brit. Med. Journ.*, 1910, ii, 941, and *Trans. Med. Soc.*, 1922-23, xlvii, 127.

chloroform and ether but has reduced it to 9.4 per cent in 53 operations since the war under spinal and gas and oxygen anaesthesia. He attributes this great reduction to the elimination of shock by the change of anaesthetics but some of it is probably due to other improvements in technique. As stovaine anaesthesia begins to wear off at the end of an hour Miles in difficult operations likely to last more than an hour injects 2 per cent novocain into the sacral canal to anaesthetise the perineum for two or three hours longer. The high Trendelenburg position is adopted and a long vertical incision made half an inch to the left of the middle line and extending from the pubic crest to a point an inch or two above the

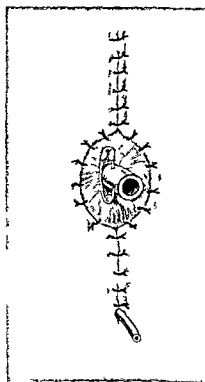


FIG. 43. Perineal excision of the rectum completed

umbilicus. This left paramedian incision gives better access to the left side of the pelvis where the dissection is usually the most difficult. The abdomen is rapidly but carefully explored, the hand being first passed up to examine the liver for any secondary growth there or in the general parietal or visceral peritoneum. Proves that it is too late for resection. Extension of the growth to the bladder makes it impossible to remove it completely and satisfactorily and invasion of the vagina or cervix uteri may also prohibit resection especially if it involves hysterectomy which adds seriously to the severity of the operation. The same is true for extensive or fixed enlargement of the aortic or left iliac glands but enlarged glands in the pelvic mesocolon or localised plaques in the pelvic peritoneum do not necessarily prohibit resection if they can be removed with the primary growth when either the primary carcinoma or secondary

nodules have penetrated the peritoneum, the probability of general carcinomatous infection of the peritoneum is great.

When there are no contra-indications, a self-retaining retractor is inserted, and the intestines are displaced upwards and retained in the upper abdomen by means of a large, warm and moist gauze pad. The pelvic colon is brought out of the wound and held forwards while the

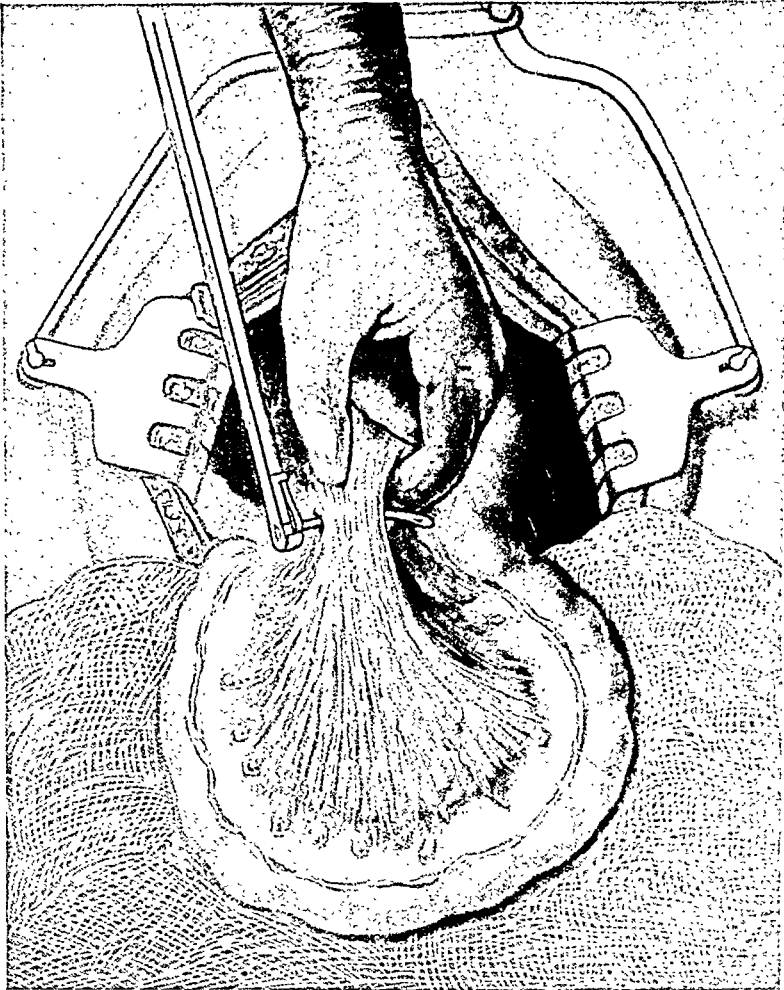


FIG. 438. Abdomino-perineal excision of the rectum. (After W. E. Miles.)
Ligation of the inferior mesenteric vessels below the origin of the upper sigmoid artery, after lifting up the pelvic mesocolon.

reflection of the mesocolon to the left iliac fossa is picked up and incised. Two fingers are inserted in the opening thus made to separate and lift up the peritoneum, so that the incision can be extended to the required degree without loss of blood. The left ureter is soon identified and displaced backwards. While the middle of the pelvic colon is held forwards, the prominent inferior mesenteric vessels are firmly tied with two strong catgut ligatures, introduced by means of an aneurysm needle inserted an inch below the origin of the upper sigmoid artery. The vessels and their

ensheathing mesentery are divided between the ligatures thus freeing the bowel and making the rest of the abdominal dissection almost bloodless. When the sigmoid arteries are so embedded in fat that they cannot be identified it is safe to tie the inferior mesenteric vessels just below the level of the bifurcation of the aorta.

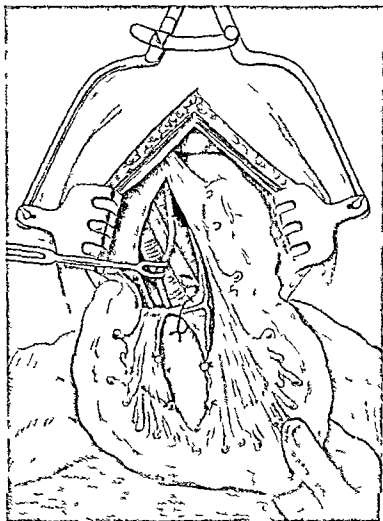


FIG. 439. Abdomino-perineal excision of the rectum. (After W. F. Miles.) Division of the peritoneal reflection separation of the colon from the posterior abdominal wall. The colon is not divided at this stage.

The reflections of the pelvic mesocolon divided downwards to the sacrum and the fingers of the left hand are inserted behind the bowel to separate it from the sacrum as far as the sacro-coccygeal joint. As a rule this separation is through loose connective tissues and is easy but a few adhesions may require division with blunt pointed scissors curved on the flat. As the rectum is lifted and held forwards by the left hand the thin lateral peritoneal reflections are defined and divided with scissors.

without endangering the ureters, which are displaced backwards and protected by the left hand.

The lateral incisions in the peritoneum are carried forwards to meet in front of the rectum, behind the bladder in the male or the vagina in the

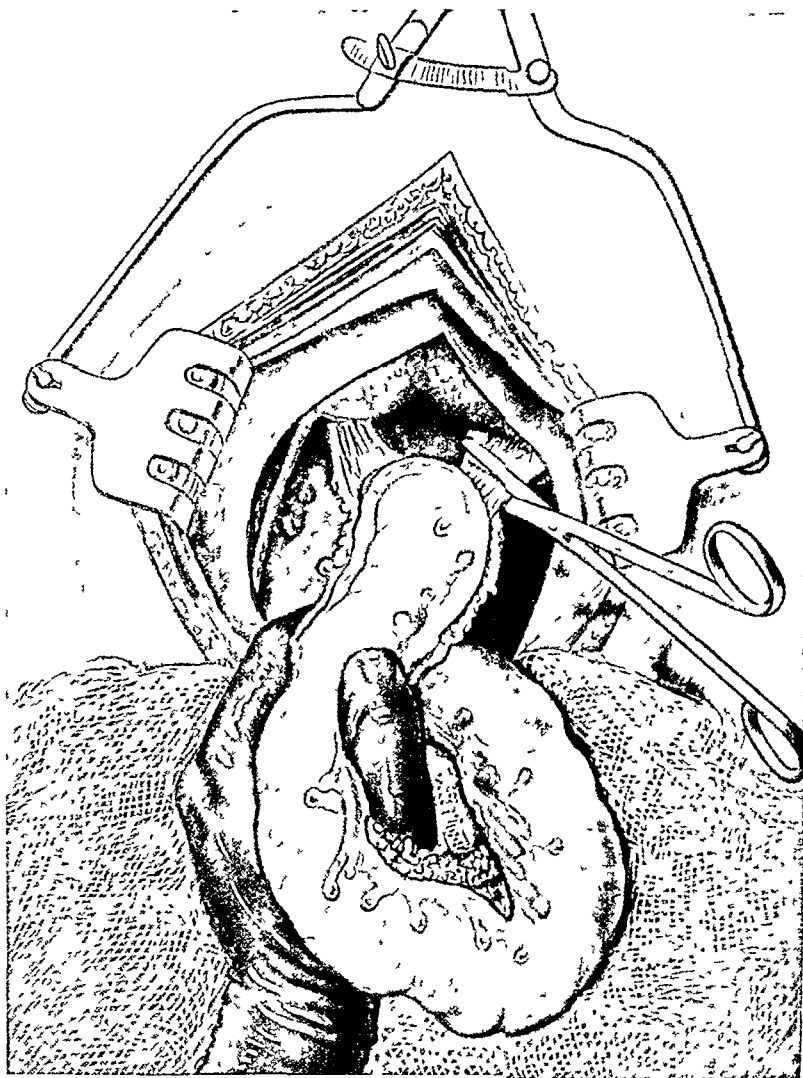


FIG 440. Abdomino-perineal excision of the rectum. (After W. E. Miles) The peritoneum has been divided on either side of the rectum, and the bowel has been separated in front as far as the base of the prostate; the lateral ligaments are being divided after drawing the ureters aside

female. By blunt dissection the rectum is carefully separated in front from the bladder and vesiculæ seminales until the prostate is reached. In the female the separation from the vagina is easy. The rectum is held up by an assistant while the surgeon demonstrates and divides its lateral attachments, which consist of broad, strong, fibrous bands extending to the lateral walls of the pelvis, and carrying the small middle hæmorrhoidal vessels. They are best divided with scissors and tied if necessary.

The bowel being now free, the pelvic colon (about four inches from its upper end) is crushed with a powerful clamp, one inch wide ; the crushed part is tied at either end by a strong ligature and divided between the ligatures. The ends are protected by pieces of rubber sheeting tied over them. The upper end is used for making the colostomy and is brought out through a stab wound, about an inch long, made across the middle of a line extending from the navel to the left anterior superior spine.

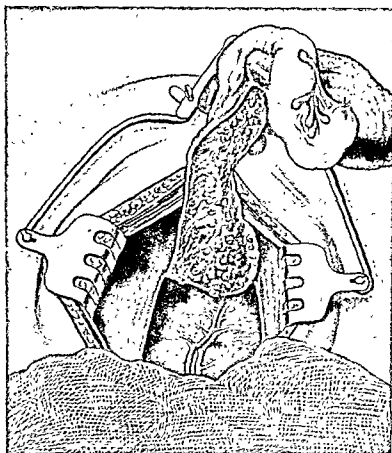


FIG. 441. Abdomino-perineal excision of the rectum. (After W. E. Miles.)
Separation of the rectum from the sacrum

It is fixed to the skin by two sutures of linen thread. The other end of the bowel is placed in front of the lower part of the sacrum. The pelvic peritoneum is brought up and sewn above the pelvic colon, thus re-establishing the pelvic peritoneal floor on a higher plane. It is not easy to do this, but flaps may be raised from the vesical peritoneum in the male and from the posterior surface of the broad ligaments in the female. These are sewn to the remaining margins of the pelvic mesocolon. In some cases it is necessary to use an omental graft to supplement the flaps. The packs are removed, the lower margin of the great omentum is brought down into the pelvis and the abdomen is closed in layers ; a temporary dressing is applied and fixed (see Figs. 442 to 444).

(b) *Perineal Part.* The patient is placed in the right lateral position with the thighs well flexed and the buttocks projecting over the edge of the table. The parts having been thoroughly cleansed and the anus closed with a strong purse-string suture, the skin is painted with tincture of iodine and a transverse incision, three inches long, is made over the sacro-coccygeal joint. From the middle of this another incision is carried down in the middle line to within an inch of the anus and widely around the latter, racket fashion. The skin flaps are raised, and the

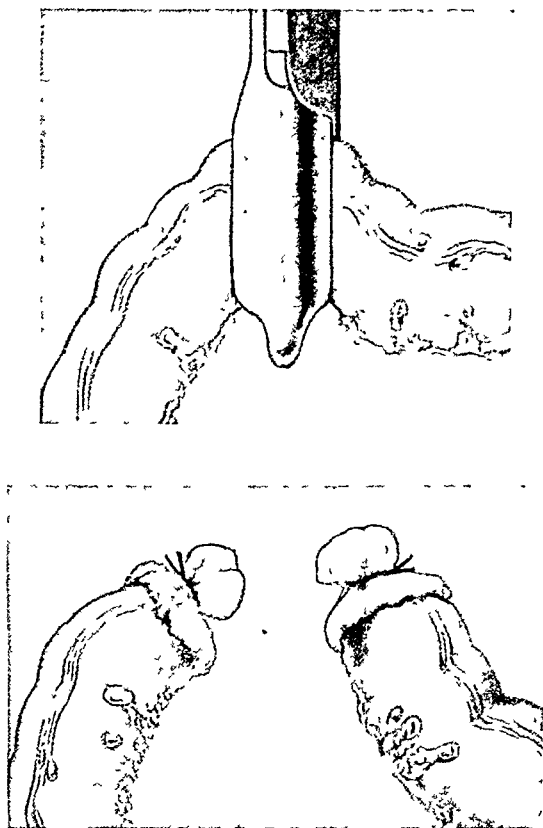


FIG. 442. Abdomino-perineal excision of the rectum. (After W. E. Miles.) The colon is crushed, divided, tied and sealed off by rubber sheeting tied over the ends.

coccyx is flexed and disarticulated from the sacrum. The pelvic fascia, in front of the lower end of the sacrum, is freely divided, thus opening the pelvic cavity and exposing the loop of pelvic colon and rectum to be removed. The left forefinger is passed above the muscles of the pelvic floor, which are divided on either side close to the lateral wall of the pelvis. The pelvic colon and rectum are drawn down while the lower part of the latter is very carefully separated from the prostate and urethra or vagina. The fatty tissues of the ischio-rectal fossa are taken away with the bowel. The inferior hæmorrhoidal vessels are divided and have to be tied. In some cases the invaded prostatic capsule or posterior vaginal wall has to be excised.

After all bleeding has been arrested the large cavity left after the removal of the rectum and pelvic floor is swabbed out with 1-500 solution of biniodide of mercury and lined with sterilised rubber sheeting into which sterilised gauze is packed to support the peritoneum of the new

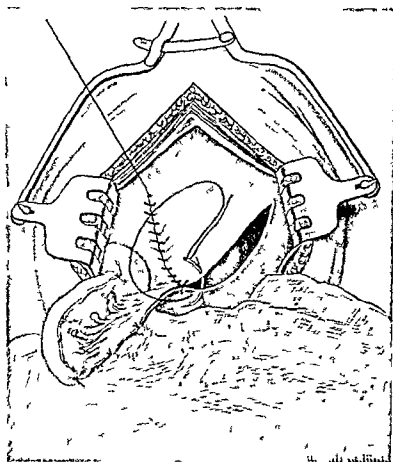


FIG 443 Abdomino-perineal excision of the rectum showing method of restoring the pelvic floor of the male. A flap of peritoneum has been dissected up from the bladder and drawn backwards until it meets the cut edge of the pelvic mesocolon to which it is sutured. The distal portion of the pelvic colon can be seen lying in the pelvic cavity below the new pelvic floor. (After W. F. Miles.)

pelvic floor. The wound is closed with interrupted sutures except where the drain protrudes.

A self-retaining soft rubber catheter is inserted into the colon at the colostomy and used for introducing saline or glucose solutions into the bowel. It also allows gas to escape and prevents undue distension until the colostomy is freely opened at the end of forty-eight hours.

In the after-treatment warmth and saline infusions into the colon or axillæ are of great value. The gauze pack is easily and painlessly removed on the second or third day without disturbing the rubber sheeting. Fresh gauze is loosely packed in, but it and the sheeting are finally removed on the fourth day when the wound is irrigated with carbolic acid solution.

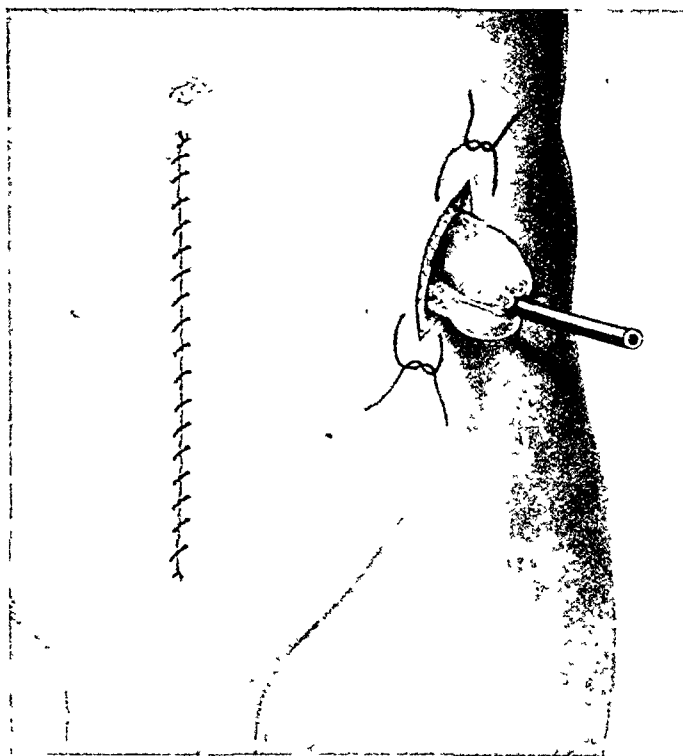


FIG. 444. Abdomino-perineal excision of the rectum. Colostomy with catheter fixed in the inverted end of the colon for the administration of glucose salines.

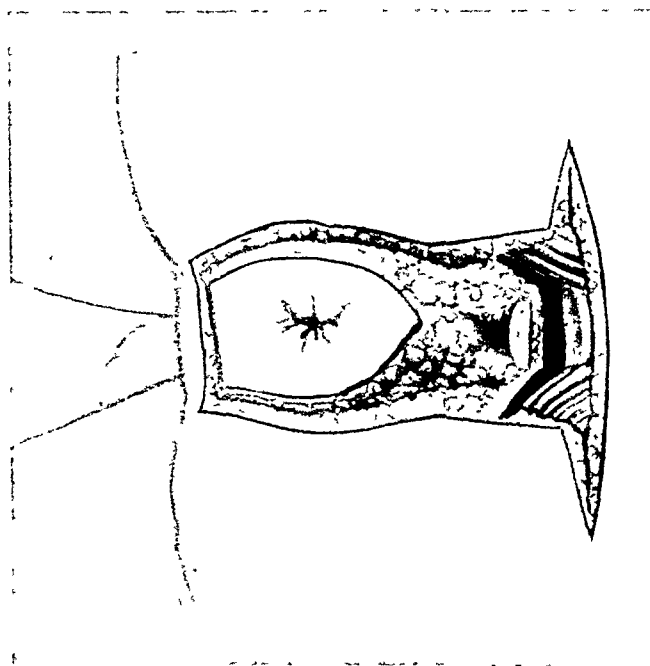


FIG. 445. Abdomino-perineal excision of the rectum, showing the reflection of the skin-flaps and opening of the sacro-coccygeal joint. When the surface incisions around the anus are deepened, as much as possible of the ischio-rectal fat is included. (After W. E. Miles.)

(1 per cent) followed by normal saline. The irrigation is repeated daily.

The patient is moved and is encouraged to move his limbs as much as possible from the first, to sit up in bed after a week and to get up and walk a little at the end of a fortnight thus hastening the obliteration and healing of the large pelvic space. Retention of urine is common from temporary paralysis of the bladder therefore a catheter must be either

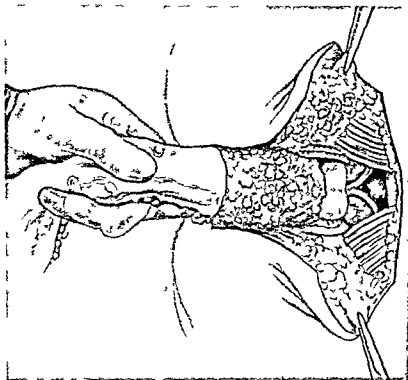


FIG. 446. Abdomino-perineal excision of the rectum showing the pelvic colon and the isolated upper part of the rectum withdrawn from the cavity of the pelvis. If the isolation of the rectum has been efficiently carried out anteriorly, posteriorly and laterally the bowel can be readily withdrawn in the manner shown and the base of the bladder, the vesiculae seminales with the vasa deferentia and the prostate gland are clearly exposed to view. The levatores ani are then divided close to their origin from the pelvic wall. (After W. E. Miles.)

tied in for a few days or passed three or four times in the twenty-four hours until the natural power returns. After tying in a catheter with its beak only just within the bladder and leaving it in for four or five days, it is taken out in the morning and left out if voluntary micturition is possible during the day. It may be passed again every evening as long as any residual urine collects.

Complications. Shock, intestinal obstruction and pulmonary complications.

Results. With perseverance and attention to every detail of the operation and after treatment Miles has been able to reduce the mortality from 36 per cent to 9.4 per cent in recent years since the war. He

considers that about 50 per cent. of his patients are cured or free from recurrence five years after the operation.

(4) **Abdomino-Anal Excision. Restoration of the Natural Anus.** Both surgeons and patients have been anxious to restore the natural functions of the anus after excision of the rectum by the abdomino-perineal method. Maunsell¹ described a method of achieving this object, and Weir,² Sir Charles Ball,³ the late Dame Aldrich-Blake⁴ and others improved upon this plan.

It is unfortunate, however, that the attempt to restore the natural anus adds a little to the danger of the operation and to the risk of recurrence,

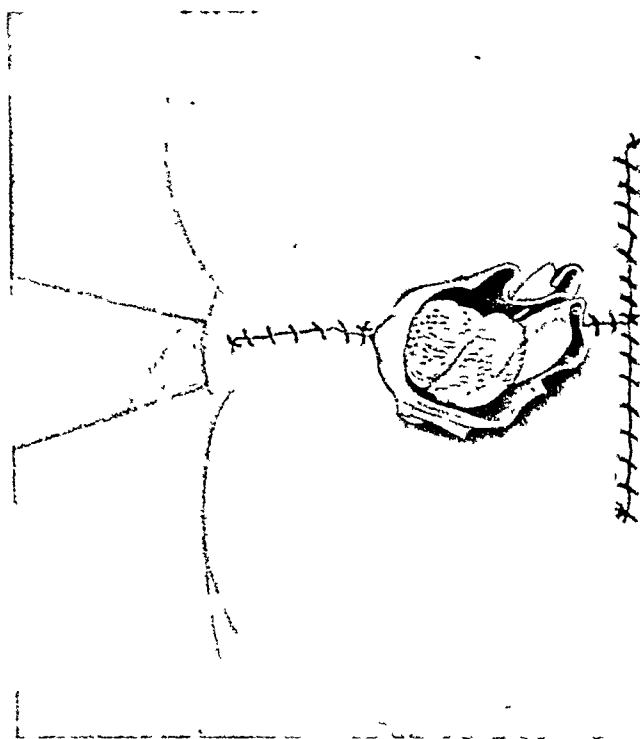


FIG. 447. Abdomino-perineal excision of the rectum. Completion of the perineal part of the operation. (After W. E. Miles.)

so that most surgeons have abandoned the endeavour. But some very good results have been obtained. One of us had a lady patient who survived fifteen years without recurrence, and with almost perfect function after this operation. Some patients may desire to take a greater risk in the hope of retaining the natural functions of the bowel. The colon and rectum are mobilised as described under the abdomino-perineal operation, but the bowel is not divided. The inferior mesenteric vessels are carefully examined and tied a little above the origin of the lower sigmoid artery (see Fig. 448). A ligature is tied around the bowel at the point which is considered most suitable for joining to the anus. This

¹ *Lancet*, 1892, ii, 473.

² *Journ. Amer. Med. Assoc.*, 1901, ii, 801.

³ *Brit. Med. Journ.*, 1903, i, 540.

⁴ *Idem*, 1903, ii, 1586.

must be at least four inches above the growth, and it is often a mechanical advantage to select a higher and more movable point. The bowel must

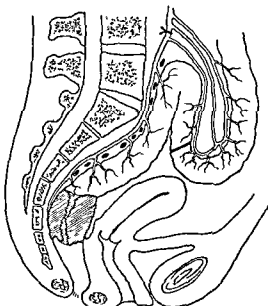


FIG. 448 Abdomino anal resection The ligature is in the superior hæmorrhoidal artery, above the communication of the sigmoid arteries with it

have a good blood-supply down to the point selected. The ends of the ligature are left long. If the bowel that can be saved appears too short

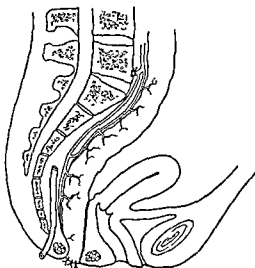


FIG. 449 Abdomino anal resection The pelvic colon has been brought to the anus

to come down to the anus without tension, it can generally be lengthened by further mobilisation of the descending colon even as far as the splenic

flexure. If these steps are not effective a permanent colostomy must be adopted as in Miles's operation. The freely movable bowel is now pushed down into the pelvis and the pelvic peritoneal floor is reconstituted

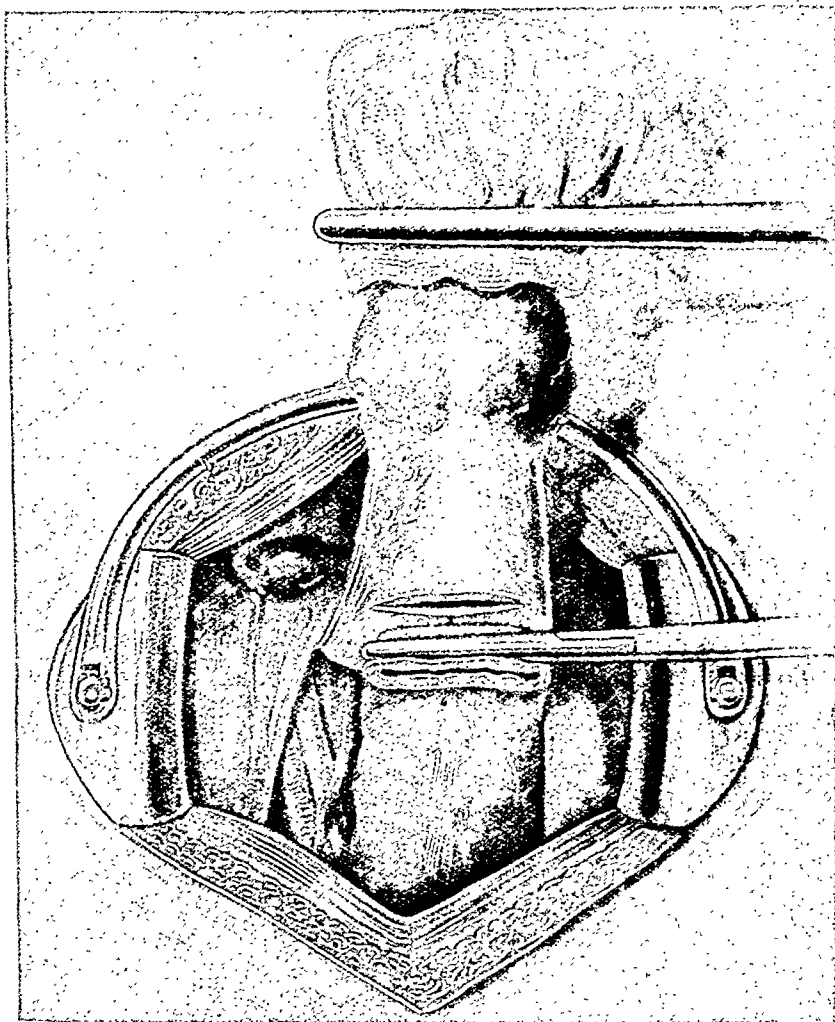


FIG. 450. Abdominal excision of a growth of the upper part of the rectum or pelvirectal junction. The part to be removed is used as a tractor to aid the anastomosis. The posterior part of the superficial suture has been inserted. Then the piercing suture is inserted as the rectum is gradually divided.

around the bowel with the greatest care to avoid any gap between the sutures.

The Trendelenburg position is abandoned, the gauze packs are removed, and the abdomen is rapidly closed in layers in the usual way. Then the patient is placed in the left lateral position. The anus is closed with a strong purse-string suture, and an incision is made around the anus and carried backwards to the base of the coccyx. The fibres of the external sphincter and deep muscles of the pelvic floor are rapidly separated in the middle line, and the loose connective tissues behind the rectum are

opened. Two fingers of the left hand are introduced into the pelvis to hook down the loose coil of bowel lying there. Gentle traction is made upon this while the lower end of the bowel is separated from its bed, care being taken neither to damage the muscles of the pelvic floor nor to divide the anterior commissure of the external sphincter. Now a great length of unopened bowel including the growth hangs out of the wound. The ligature indicating the point selected for section is identified and should reach the anus without tension. The assistant holds the bowel forwards in contact with the anterior commissure of the sphincter as the

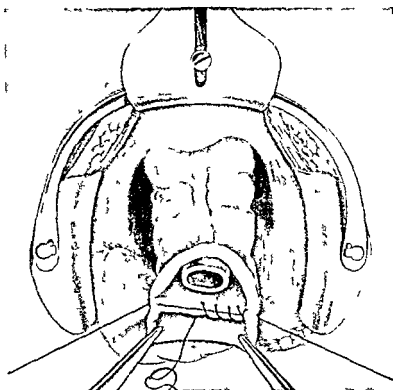


FIG 451. Abdominal resection and union with the aid of a tube. The deep or piercing suture is being inserted. The union often has to be made much lower in the pelvis. (After D. C. Ballfour.)

surgeon fixes it to the levatores ani and sphincter by means of several catgut sutures picking up the appendices epiploicæ and the longitudinal muscular bands. Then the muscles are brought together accurately behind the bowel and sewn with interrupted catgut sutures. Three or four strong salmon gut sutures are passed with long curved needles through the skin and structures of the pelvic floor closing the wound behind the bowel except at its posterior extremity where a soft split rubber tube reaching into the hollow of the sacrum is sutured to the skin (see Fig 449). Then the bowel projecting at the anus is divided with the cautery between two clamps and sewn to the skin by a continuous silk suture. When the clamp is slightly loosened the cut end of the bowel should bleed freely and there should be no tension upon the bowel. As a rule the part removed is

about ten inches long and includes all the primary lymphatic glands in the pelvic mesocolon. The operation lasts from fifty minutes to an hour and a half, taking longer in men than in women.

(5) **Abdominal Resection** is suitable for growths of the lower part of the pelvic colon and the upper part of the rectum, but the anastomosis is difficult and dangerous unless it is made over a tube as recommended by Rutherford Morison and, later, by Lockhart-Mummery in 1907. In 1910 D. C. Balfour¹ gave an account of the operation which had been used at

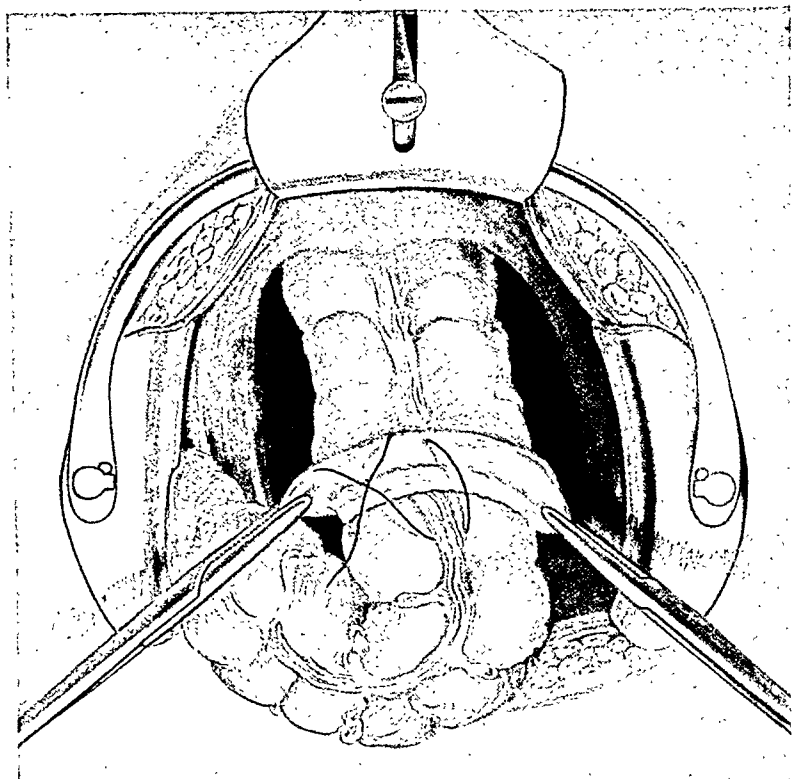


FIG. 452. Abdominal resection. The pelvic colon is invaginated into the rectum. The union is often much lower. (After D. C. Balfour.)

the Mayo Clinic for several years. Improvements of technic have extended the use and improved the results of this excellent method.² It enables us to remove growths of the upper part of the rectum and to make an anastomosis in the pelvis with comparative safety, and also to avoid either temporary or permanent colostomy in many difficult cases.

The rectum is washed clean two hours before the operation. The pelvic colon and upper part only of the rectum are mobilised, and the inferior mesenteric vessels are tied as already described. The lateral ligaments of the rectum with the vessels contained in them are not divided. The pelvic colon is divided between clamps placed at least six inches above the carcinoma. The ends are sterilised with the cautery and the lower one is

¹ *Ann. of Surg.*, 1910, li, 239.

² D. C. Balfour, *Collected Papers of the Mayo Clinic*, 1919, xi, 147.

covered by a piece of rubber sheeting clamped over it (Fig 150) Gentle traction upon the part of the bowel containing the growth which is often friable greatly facilitates the anastomosis Clamps are placed above and below the line chosen for the lower section—at least two inches below the growth The posterior half of the sero muscular suture (No 0 catgut) is inserted The deep perforating suture of No 1 chromic catgut is inserted as the rectum is gradually divided A rubber tube half an inch

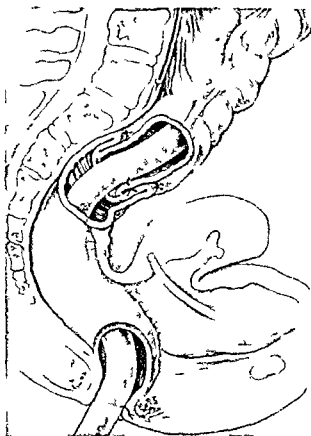


FIG 453 Abdominal resection with the aid of a rubber tube The union and invagination are shown the tube is fixed by stitching it to the pelvic colon and to the anus (After D C Balfour)

in calibre is then passed into the lower bowel and drawn out through the anus by an assistant The upper part which has a lateral opening near its extremity is passed into the colon for about six inches and secured in position by a catgut suture at the anastomosis which is completed by continuing the deep and superficial sutures until they encircle the bowel The upper part of the bowel is invaginated into the lower part (Fig 452) by holding the latter with forceps while an assistant pulls the rubber tube projecting from the anus the invagination is maintained by four serous sutures of fine catgut When the lower section has to be made very low it is impossible to introduce two layers of sutures Under these circum

stances four long sutures of No. 2 chromic catgut may be introduced into the lower bowel with a fish-hook needle below the site and before the lower section is made. The large rubber tube is fixed in an air-tight manner in the colon as in cholecystostomy, and then the four long sutures are passed, as in Connell's method, through the colon, one in front, one behind, and one at either side. These are tied as the tube, passed down through the anus, is pulled further down by an assistant. The peritoneum of the pelvic floor is reconstituted and the abdomen is closed, except when a rubber tube is used to drain the pelvis. The rectal tube generally comes away in about five or six days, when the catgut is absorbed.

Causes of Death after Excision of the Rectum. (1) Sepsis due to soiling of the wound or peritoneum with faeces is the chief cause of failure, and this can be greatly diminished by preliminary colostomy and refinements of technic designed to prevent leakage during and after operation.

(2) **Hæmorrhage.** This will rarely be difficult to deal with at the time or met with later if the surgeon does the operation methodically and takes care to tie the vessels.

(3) **Shock.** This has been almost eliminated by regional and sacral anaesthesia combined with gas and oxygen.

(4) **Nephritis,** due chiefly to sepsis and cystitis following paralysis of the bladder and the need of catheters; sometimes one or both ureters may be injured.

(5) **Intestinal Obstruction,** a piece of small intestine getting obstructed by slipping into an aperture between sutures used to close the pelvic floor or to close apertures in the mesentery or near the colostomy.

Mortality.—Out of 753 patients¹ suffering from carcinoma of the rectum, or recto-sigmoid at the Mayo Clinic, between the beginning of 1893 and the end of 1915, 430 were subjected to radical operation, with a mortality of 15·5 per cent. Before 1910 the mortality was 17·8 per cent.; between 1910 and 1913, it was 17·7 per cent., when 51 per cent. of the patients presenting themselves were submitted to radical operation. For the years 1913, 1914, and 1915 the mortality averaged 12·5 per cent., although the operability had gone up to 71·8 per cent.

More recent statistics of the results of particular operations performed by individual experts are given on pages 786 and 799, but these results are better than the average.

W. B. Gabriel,² in a valuable contribution, gives the results of the 143 perineal excisions, with preliminary permanent colostomy, for carcinoma of the rectum, which were performed at St. Mark's Hospital from 1910 to July, 1924; there were 22 deaths in the hospital following the operation, giving an immediate mortality of 15·4 per cent. During the last three years of the period mentioned the mortality had been reduced to 12 per cent. in 58 operations. The increased risk of the operation in males is shown by a mortality of 18 per cent. in them compared with 11 per cent. in females: this is in agreement with common experience.

The Hope of Cure. Volkmann in 1878 claimed three complete cures, and several cases of very late recurrence—one after six, one after five, and

¹ W. J. Mayo, *Ann. of Surg.*, 1916, lxi, 304.

² *Brit. Journ. Surg.*, 1925, xii, 466.

one after three years. One died of carcinoma of the liver eight years after operation without local recurrence.

W. J. Mayo¹ states that 'of the 130 patients in whom a resection was done 334 recovered from the operation. Eliminating those who were operated on less than 3 years ago we have 33.3 per cent who lived 3 years or more and 28.3 per cent who lived 5 years or more after the operation. These percentages may be increased fairly to 37.5 per cent and 35.9 per cent respectively by subtracting from our mortality figures the normal death rates for corresponding ages for periods of 3 and 5 years, i. e. 4.2 and 7.5 per cent.

More recent statistics of the ultimate results of particular operations are given on pages 787 and 800.

W. B. Gabriel² laboriously followed up 121 patients discharged from St. Mark's Hospital after perineal excision and found that when recurrence takes place it causes death as a rule inside five years after operation (93 per cent.) and that 80 per cent of these deaths occurred inside three years. Excluding all cases operated upon less than three years earlier Mr. Gabriel found that 23.5 per cent (20 out of 85) of the numbers submitted to operation were alive without evidence of recurrence three years after operation and 21 per cent (15 out of 63) were well five years after operation.

¹ *Loc. cit.*

² *Loc. cit.* p. 471.

CHAPTER XXIX

RUPTURED PERINEUM

THE following account is taken from Dr. Galabin : ¹

A. Operation for Partial Rupture (Fig. 454). The patient is placed in lithotomy position. The need for assistants to support the thighs is avoided if a "Clover's crutch" is used.

"The extent of surface to be freshened is indicated, to some extent, by the cicatrix left by the rupture. It is well, however, to go a little

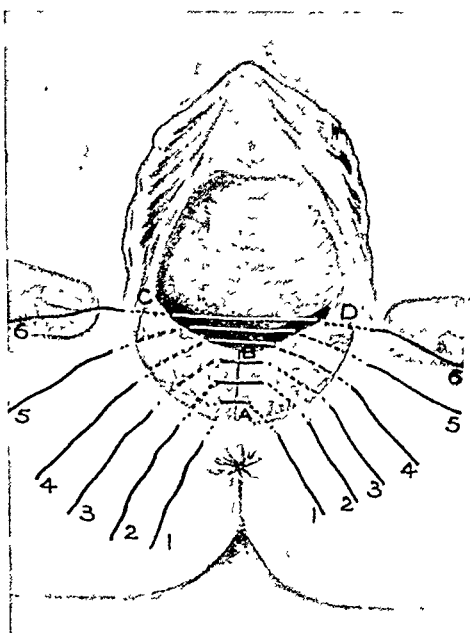


Fig. 454. Partial rupture.

beyond the limits of this in all directions, especially up the median line of the vagina and towards the lower halves of the labia majora, both in order to secure, if possible, a perineal body somewhat larger and deeper than the original one, and to allow some margin, in case the surfaces do not unite completely up to the edges. To put the mucous membrane on the stretch, an assistant at each side places one or two fingers on the skin of the thigh and draws the vulva outwards (Fig. 454). The skin just beneath A, in front of the anus, may also be seized by a tenaculum and drawn downwards. If still the mucous membrane is not sufficiently on the stretch, from laxity of the vagina, the posterior vaginal wall, some distance

above B, should be seized by a vulsellum and pushed upwards. Incisions are then made through the mucous membrane from B to A, in the median line of the vagina, and from A to C and D through the junction of mucous membrane and skin. These should not be extended in the direction of C and D farther than the lower extremity of the nymphæ at the utmost. There are then two triangular flaps, ABC and ABD. These are to be dissected up from the apex A towards the base BC and BD, the corner of the mucous membrane at A being seized with dissecting forceps. The dissection should not be deeper than necessary, and if it is done with the knife the surfaces are more ready to unite. If, however, there is much tendency to bleed, scissors may be used. The

¹ *Diseases of Women*, 1903, p. 618. Any one making trial of this method will agree with me as to its simplicity and excellent results.

apices of the flaps are then cut off with scissors leaving an upturned border along BC and BD. When the surfaces are drawn together these borders form a slightly elevated ridge towards the vagina and if there is any failure of union just along the edge they fall over and cover it.

Silkworm gut sutures are then placed as shown in the figure by means of Hagedorn's needles of half circle curve. Another mode is to bury the sutures 1, 2 and 3 in the tissues throughout their whole course. If however they are brought out in the centre for spaces alternately short and long (Fig. 154) the surfaces are more easily brought into contact at all levels without undue tension. In passing sutures 4, 5, 6 the needle should be brought out precisely on the margin along which the border of mucous membrane BD is turned up from the vagina not passing through the mucous membrane itself and passed in again on the corresponding spot on the margin BC to be brought out so as to include the skin of the perineum. The sutures are then tied in the order of the numbers 1 to 6 care being taken that the surfaces are brought just sufficiently into apposition and that no clots of blood are left between them. The bleeding if any continues is arrested by bringing the surfaces together and if they are properly united there will be no secondary hæmorrhage unless the sutures begin to cut from excessive tension. The sutures may be left in from seven to nine days.

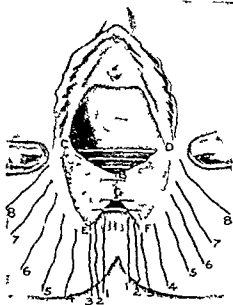


FIG. 150. Complete rupture.

Operation for Complete Rupture (Fig. 150)

A sponge tied by a tape is passed into the bowel and preliminary steps are taken as above. A point B in the median line of the vagina a sufficient distance above the apex of the rent in the septum is taken and an incision through the mucous membrane is made from B to G and from G to E and F along the edges of the septum between the rectal mucous membrane and the cicatrix. Incisions are also made through the skin from E to C and F to D so that the freshened surface may extend somewhat beyond the limits of the cicatrix left by the rent. C and D not to be higher than the lower extremities of the nymphæ. The quadrilateral flap EGBC is then seized at E by dissecting forceps and dissected up with the knife from the angle E and afterwards from the angle G towards the base BC. While this is done the parts are kept on the stretch by an assistant drawing down the skin below E with a tenaculum. The flap is then cut away with scissors except an upturned border which is left along BC. The flap FGDB is treated in a similar manner. If as is usual the ends of the

sphincter at E and F have retracted from the margin of the cicatrix, it is well to cut away with the scissors a narrow strip of rectal mucous membrane, generally somewhat everted, a short distance from E and F towards G, so as to bring the freshened surface to the ends of the sphincter.

“Sutures are then applied in the following manner: First, rectal sutures of chromic gut, either two or three, according to the extent of the rent in the septum, are applied. These are destined to be tied in the rectum, and left to be absorbed, the ends being cut short. They are best applied with Hagedorn’s needle-holder and needle. The needle is passed in a little distance from the margin of the rent, and brought out almost at the very edge of the rectal mucous membrane, on the line GF. The needle is then threaded at the other end of the suture, and that is drawn through in the same way from without inwards, emerging on the margin EG. The remaining sutures should be of stout fishing-gut. One or two sutures may be first passed completely round through the remnant of the septum by means of a Hagedorn’s needle. The first of these (3, Fig. 455) is passed in somewhat behind and below the angle F, so as to take up, if possible, or at least go quite close to, the end of the divided sphincter, and is brought out in a similar position near E. Thus, when tightened, it brings together the ends of the sphincter, drawing it into a circle; but it often brings into apposition, not so much the freshened surfaces above as the unfreshened rectal mucous membrane. This serves as a barrier to keep out *fæcal* matter, while the next suture (4, Fig. 455) aids the rectal sutures in uniting the freshened surfaces. The remaining sutures are passed as shown in the figure (5—8, Fig. 455) by a Hagedorn’s needle, in the same way as in the operation for incomplete rupture. The needle is passed in pretty close to the edge CE or FD, and is brought out (except in the case of suture 5, Fig. 455) on the line where the margin CD or DB is turned up. On the opposite side it is passed in a similar way from within outwards. The effect is, that when the sutures are tightened the margins BC, BD, are turned up into a slight ridge towards the vagina, and afterwards fall over and cover any portion of the vaginal border which does not unite quite up to the edge. Suture 5 (Fig. 455) may either be buried throughout, or brought out for a very short space near the median line BG.

“When all the sutures are in place, the sponge is withdrawn from the rectum, and the rectal sutures are tied first. Care must be taken to draw up the whole of the slack in the centre, and bring the edges EG, FG, perfectly together. This will approximate the ends of the sphincter to a great extent, and the approximation is completed by tightening suture 3. The remaining sutures are then tied in the order of the numbers, care being taken to allow no clots of blood to remain between, and to tighten them just enough to bring the surfaces in contact. The ends of each perineal suture should be tied together, and left rather long, so as to be less likely to prick the skin. After three clear days an action of the bowels is obtained by a dose of an ounce of castor oil. *Enemata* should be avoided if possible, but may be necessary if a collection of *fæces* has formed in the rectum. Special care must be taken that no collection of hard *fæces* takes place for the first two or three days after removal of the sutures.

“The perineal sutures are removed in seven or eight days.

‘ In some cases by the primary operation after labour, only superficial union is secured and a recto vaginal fistula is left close to the part united. The best plan is then to cut through the bridge of union with scissors at the time of the operation and then proceed as in the case of complete rupture. This is the only way to secure a firm and thick perineum and is less likely to fail than an operation on the fistula alone.

CHAPTER XXX

OPERATIONS ON THE OVARY AND APPENDAGES

OVARIOTOMY

ONE or two practical points will be alluded to before the operation is described.

Date of Operation. An ovarian tumour should be removed as soon as possible after its discovery. For by delay not only is the patient subjected to the risk of accidents in connection with the tumour itself, but her general health is likely to suffer from the effects of pressure on neighbouring organs.

Accidents in Connection with Tumour. The accidents to which an ovarian tumour is liable should be borne in mind. They are, shortly, as follows :

(1) *Inflammatory Changes.* These, whether confined to the peritoneal covering or dependent upon inflammatory and necrotic changes in the cyst itself, will lead to adhesions between the tumour and the abdominal wall or viscera. When recent these adhesions may readily be separated, but when old and fibrous they may lead to serious difficulties in the course of the operation. The contents of the cyst may suppurate, and, fouling the peritoneal cavity, lead to suppurative peritonitis.

(2) *Torsion of the Pedicle.* When slowly produced, the interference with the blood-supply to the tumour will set up necrosis and so render the cyst wall liable to rupture. Acute torsion will lead to bleeding, which may be so profuse as to rupture the cyst wall and endanger the patient's life. Under these circumstances an immediate operation is called for, with all the disadvantages that an operation of urgency entails.

(3) *Rupture of the Cyst.* This may, as has been mentioned, follow necrotic changes in the cyst or torsion of the pedicle. It may, in addition, depend merely upon thinness of the wall or upon weakening due to the extension of growth from the interior through the cyst wall. As a result the contents become disseminated through the peritoneal cavity, setting up peritonitis in certain cases, or leading to a general infection of the peritoneum with secondary growths in others.

(4) *Malignancy.* We have, finally, to remember this important practical point, that it is difficult at an early stage to say whether we are dealing with a malignant growth or not. It is especially in children that an early removal is demanded, for in them the proportion of malignant tumours is much higher than in adults.

General Condition of the Patient. The condition of the viscera, kidneys, lungs, &c., the habits of the patient, her digestive powers, must all be carefully noted. For upon a consideration of these points not only does the prognosis to some extent depend, but also the nature and duration of the treatment to be adopted preparatory to the operation. Age need

not be regarded as a bar to operation Sir J Bland Sutton has collected 11 cases of ovariectomy in women over 80, all of whom recovered ¹

As regards difficulties likely to be met with in the course of the operation, some information will be obtained from the history of the patient and from careful examination Attacks of pain will point to peritonitis and adhesions An examination of the tumour will give some idea of its mobility, of the proportion of solid matter &c

The Operation The ovarian tumour should, when possible, be removed entire This certainly applies to all cysts which can be taken out through a sub umbilical incision Where the cyst can be removed at all through an abdominal incision I have no hesitation in prolonging the incision upwards to the left of the umbilicus as far if necessary, as the ensiform cartilage, preliminary tapping being reserved for such enormous growths as cannot be taken out entire in this way I am satisfied that by this procedure there has been a great diminution in the number of recurrences due to infection of the peritoneal cavity from leakages during operation Apart from the size of the cyst tapping is contra indicated when the tumour is made up of a number of small loculi These could only be broken down by the hand with certain fouling of the abdominal cavity It should also be avoided in cases of twisted pedicle, of dermoid tumours and when from the presence of extensive adhesions there is a probability of infection of the contents

In an easy case without parietal adhesions the pearly glistening cyst comes into view as soon as the peritoneum is incised, but if the peritoneum is thickened and adherent to the cyst there may be the greatest difficulty in deciding when this is reached and the incision may even be carried through the cyst wall In cases of difficulty the incision should be prolonged upwards to the left of the umbilicus until a spot free from adhesions is found

When the tumour is exposed it should be examined carefully by eye and hand Its nature should be noted, whether cystic or solid, or partially solid, whether a dermoid or inflamed, the presence of adhesions should be ascertained, or secondary malignant deposits, rendering further operation inadvisable

Emptying the Cyst When tapping is called for the following procedure can be followed The abdominal incision should be packed round to prevent fluid running back into the abdominal cavity The cyst is next tapped by carefully plunging in a trocar, the cyst wall being drawn forward with Spencer Wells forceps as soon as it is rendered lax by the escape of the fluid contents

As soon as the trocar is inserted into the cyst, the assistant should place a hand low down on each side of the abdomen, and press steadily and firmly By this means he not only forces out the fluid from the cyst, but keeps the abdominal incision taut over the tumour, thus preventing the contents of the cyst from running into the peritoneal cavity As the cyst empties traction is applied to it by means of forceps, and if there are no adhesions it is readily brought out of the wound

If there is difficulty in delivering the tumour, and it is clear, from the bulk of the cyst remaining after tapping that it is multilocular, it will have to be further reduced in size before extraction If it is multi-

¹ Bland-Sutton, *Surgical Diseases of the Ovaries and Fallopian Tubes* 1896 p 175

locular, it must be tapped again in two or three more places by removing the trocar and closing the puncture with cyst forceps, and then, while the cyst is dragged forward and steadied, the first trocar or a smaller one is thrust in at other spots where fluid is still present. This is a better practice than thrusting the trocar from the first puncture into other parts of the cyst in the dark. If this latter method is adopted, the hand should first be passed into the abdomen to make sure that the trocar does not perforate the cyst wall and injure the viscera.

Treatment of Adhesions. As the cyst is drawn forwards, any adhesions that are present must be dealt with, and the ease with which they are separated will depend upon whether they are recent or not. Those

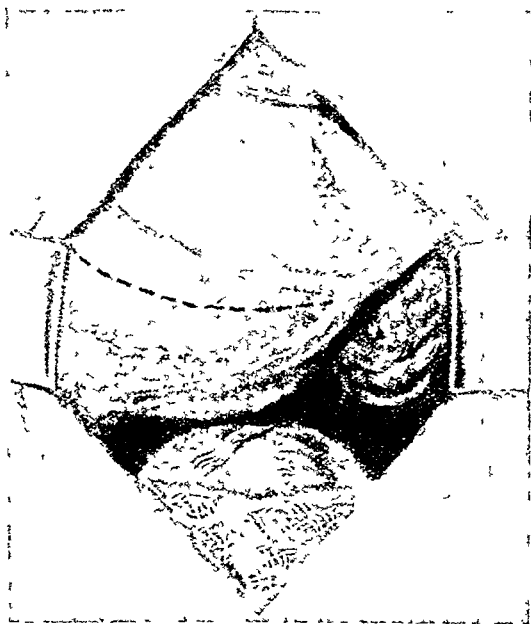


FIG. 456. Cyst of the broad ligament. Incision through peritoneum shown by dotted line.

between the tumour and abdominal wall are readily separated, when recent, by sweeping the hand between the two adherent surfaces. If of longer duration the separation must be effected, bit by bit, with the fingers or scissors, any persistent bleeding-points being secured by Spencer-Wells forceps and tied. Another method is to underrun any bleeding-points, especially any obstinate ones in the parietal peritoneum. Adhesions to the omentum, which are the most common, must be ligatured and divided, the number of ligatures used depending on the extent of the adherent omentum. Mr. Herman¹ points out that holes frequently exist in

large pieces of adherent omentum, and he advises that in cutting the omentum away the incisions should be carried through these holes to obviate any subsequent risk of intestines being strangulated in them. Intestinal and other visceral adhesions may present considerable difficulties. If the bowel is adherent it should be very carefully peeled from the cyst. If it cannot be detached in this way a thin strip of the cyst wall should be cut away and left adherent to the intestines. Firm adhesions in the pelvis present the most difficulty, and in the separation of them by means of the fingers a hole may be torn in the rectum. Injury to large vessels is not common. In Dr. Baldy's *Gynecology*, however, a case is recorded in which death resulted from hæmorrhage due to injury of a large vein in the removal of an ovarian cyst. Though bleeding from large vessels is not common, it is especially in cases of extensive pelvic adhesions that we get troublesome oozing. Temporary plugging with sterilised

¹ *Diseases of Women*, 1898, p. 797.

gauze may arrest this but should it fail an attempt should be made to seize the bleeding points with forceps and secure them with ligatures. This procedure will be much facilitated by having the patient in the raised pelvis position. If bleeding cannot be arrested by these means the pelvic cavity should be firmly packed with long strips of sterilised or iodoform gauze the ends of which are brought out through the lower part of the wound. The sutures should be introduced as usual into the lower part of the abdominal incision but should be left untied ready to bring the edges of the wound together when the plug is removed. The gauze should be taken out twenty four hours after the operation. By that time it will have served its purpose the arrest of the oozing.

Treatment of Pedicle

When the cyst has been brought outside the pedicle is dealt with.

The centre of the pedicle being found a blunt pedicle needle loaded with silk (No 4) or catgut is made to perforate it here at a spot devoid of vessels. The loop of silk being drawn through and the needle withdrawn the loop is cut and the two ligatures tied firmly round the two halves of the pedicle. The cyst is then cut away not more than three-quarters of an inch and not less than half an inch from the ligatures. When this

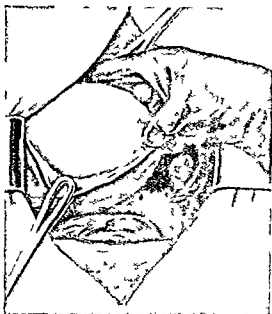


FIG. 457. Cyst of the broad ligament. Enucleation of tumour.

is done the cut end is carefully examined to make sure that no bleeding is taking place. The pedicle is then allowed to drop in and the finger following it down to the uterus finds and hooks up the other ovary. If this is found to be similarly affected it must be removed. When the pedicle is very broad it should be tied in two or three separate sections.

Drainage Different operators vary much in their practice as regards drainage and it is difficult to lay down any hard and fast rules as to when to employ it. Undoubtedly the tendency is to employ it less and less. Experiments carried out within the last few years on the absorptive powers of the peritoneum have taught us that this structure when in a normal condition is capable of absorbing large quantities of fluid and also of disposing of a considerable number of pyogenic organisms introduced into the abdominal cavity. We have to bear in mind however that a peritoneum thickened by inflammation such as we find in some cases of ovarian tumour has its functions impaired and is not in a condition to dispose of large quantities of fluid or many organisms.

Consequently fluid collecting in the abdominal cavity provides a ready medium for the growth of any organisms accidentally introduced.

Dr. Jellett¹ puts this question of drainage very clearly. "It must be regarded," he says, "as a line of treatment whose general effect is by no means beneficial, but which may have to be used at times in order to guard against a greater danger." The risks of drainage should be clearly recognised. One serious result is the weakening of the abdominal scar that attends its use, with the subsequent formation of a hernia. The drain may be a cause of reinfection of the abdominal cavity, and when a hard glass tube is employed, may, by pressure on the bowel, lead to the formation of a faecal fistula. There is one condition in which drainage is certainly called for, and that is when any septic material, as from a suppurating cyst or a pyo-salpinx, has entered the peritoneal cavity, or when any septic focus has been imperfectly removed.

Encapsuled Ovarian Cysts. Cysts of the Broad Ligament. Intraligamentous Cysts. Cases are occasionally met with in which the cyst grows between the layers of the broad ligament and has no pedicle that can be ligatured. Such a case is dealt with by shelling out the tumour from the bed in which it lies. A transverse incision having been made through the peritoneum covering it, the tumour should be enucleated by separating with the fingers the loose connective tissue that holds it in position. The removal of the cyst will be facilitated by emptying it of its contents with a trocar in the usual way. Any bleeding-points in the capsule should be seized with pressure forceps and secured. The most troublesome oozing is often found at the base of the cavity. The smaller vessels will be controlled by packing for a short time with dry gauze or with a swab wrung out of hot saline solution, the larger vessels being subsequently secured with ligatures.

After the removal of the cyst the capsule requires attention. If the cavity is small, and there is no oozing, the cut edges of the peritoneum should be drawn together by a continuous silk ligature. When the capsule is large, redundant portions having been removed, the cavity should be obliterated as far as possible by continuous or interrupted sutures approximating the anterior and posterior walls of the capsule. If there is oozing that cannot be controlled, the edges of the capsule should be secured to the lower part of the abdominal wound, and its interior packed with gauze strips. Sometimes it is found that the cyst is so firmly attached to important structures that its removal becomes an impossibility. The edges of the cyst and the capsule must then be attached to the abdominal wound, and the cavity drained. When intraligamentary growths occur on both sides, Dr. Kelly considers that it is easier and better to remove uterus and tumours together.

Incomplete Ovariectomy. The surgeon may be compelled, very early in the case, to abandon his operation. This will be rendered necessary by the following conditions: (1) When the tumour is malignant and has infiltrated tissues which cannot be safely removed, or when secondary nodules are found in the abdominal cavity. (2) When the peritoneum is found covered with papillary growths, the result of infection from a papillary cyst. Dr. H. A. Kelly² advises removal of the mother-

¹ *Practice of Gynaecol.*, 1900, p. 287.

² *Oper. Gynaecol.*, 1898, ii, 294.

tumour whenever it is possible, as he considers it not only relieves the pressure of the ascites, but checks the rapidity of the growth. More over, cases have been recorded by Mr K Thornton and others where a disappearance of the secondary papillary growths and a freedom from recurrence have resulted from this line of treatment. (3) When the base of the cyst, whether intraligamentary or not, is irremovable, deep in the pelvis, and adherent to the ureters large vessels or adjacent viscera. The surgeon must then empty the cyst of its contents, and suture its cut edge to the abdominal incision all superfluous portions of the cyst being cut away. Before doing this he must check all hæmorrhage inspect any possibly damaged viscera and carefully cleanse the back of the tumour and the parts behind it. The remains of the cyst, after being carefully sutured to the lower part of the abdominal incision so as entirely to shut off the peritoneal cavity should be packed with iodoform gauze.

Accidents during Ovariectomy (1) *Syncope* This appears to be brought about in some cases by too rapid emptying of large cysts. The pressure on the abdominal vessels is relaxed and they become filled with blood at the expense of the rest of the body. This accident should be avoided by slowly drawing off the contents of large cysts. When it occurs it should be treated by lowering the head keeping the patient warm and administering brandy subcutaneously.

(2) *Rupture of the Cyst* This accident may be expected when the walls are thin, necrotic, or softened by recent inflammation. In such cases the cyst should be carefully handled suspicious spots being kept well out of the wound or packed around with sponges. If rupture occurs, the abdomen should be well irrigated with warm boiled water and if the contents of the cyst are suppurating drained subsequently.

(3) *Injuries to Viscera* Of these the bladder small intestines rectum, and ureter are most likely to suffer. The bladder may be injured during the abdominal incision owing to its being drawn up. Or it may be opened in the course of removal of the tumour. Treatment consists in immediate suture of the organ and subsequent drainage by catheter to prevent distension. The intestine is most likely to be injured in the separation of adhesions. When possible the wound in the bowel should be at once sutured. If the damage is more extensive the question of resection of a portion of gut will arise. The rectum is sometimes torn in the separation of firm adhesions in the pelvis. The operator should attempt to sew up the rent, a proceeding that will be much facilitated by the raised pelvis position and a good light. Often suturing will be found to be impossible, and in such case the neighbourhood of the injury should be well packed with iodoform gauze, the ends of which are left out of the abdominal wound, or through an opening in the vaginal vault. For the treatment of cases in which the ureter is injured the chapter on that subject should be consulted (p 588).

(4) *Severe Hæmorrhage* It has already been mentioned that severe or fatal hæmorrhage from injury to large pelvic vessels is rare. Very severe and even alarming hæmorrhage may, however take place from the cyst wall or its interior. This is especially likely to happen when the solid contents of a papillary cyst are being scooped out by the hand. If the pedicle can be got at readily and ligatured, this should be done

quickly. If not, the advice given by Dr. H. A. Kelly ¹ should be followed : "The only safe plan is to control at once the main vessels going to the tumour by applying artery forceps to the broad ligament at the pelvic brim so as to catch the ovarian vessels, and one or two pairs at the uterine corner to catch the uterine vessels."

(5) *Leaving in Instruments.* *E.g.* sponge or forceps. The fact that this accident has occurred with operators of the largest experience should make all careful. It is best met by having a sufficient definite number to begin with and counting carefully afterwards.

REMOVAL OF THE UTERINE APPENDAGES

Indications.² Before giving these, I would state that there is no operation in which it is more necessary to consider each case on its own bearings, to explain the object and results with honourable carefulness to the friends and, whenever possible, to the patient herself, and to remember that this is above all one of those operations which should never be entertained if there are any honest doubts as to the patient's health being really impaired beyond the aid of other treatment, and the impossibility of otherwise restoring her to usefulness in the position of life in which she has been placed ; and that it is an operation which may concern the happiness of another besides that of the patient. Due weight must be given to the large part played by neuroses in this matter. Finally it is always to be remembered that it is an operation which has been greatly misused.

The following is a limited list of indications for removal of the uterine appendages :

(1) **Diseases of the Fallopian Tubes and Ovaries.** Of these the inflammatory affections concern us chiefly, in the form of salpingitis, pyo-, hydro-, or hæmato-salpinx, ovaritis, ovarian abscess, or tubo-ovarian abscess. Other diseases include ovarian new growths which have been considered under the heading of ovariectomy and tumours of the Fallopian tube, which do not call for separate treatment. It is not easy to make rules for guidance that will apply to all cases of inflammation of the appendages. Every case demands careful consideration on its own merits. The broad lines of treatment may, nevertheless, be indicated ; they are not unlike those that guide us in the treatment of appendicitis. In the following indications, Mr. Cullingworth ³ is closely followed :

¹ *Loc. supra, cit.*

² A paper read some years ago at one of our medical societies, and the discussion thereon, has brought this matter prominently before the profession. I would strongly advise my younger readers to study carefully a very weighty letter in the journals of February 7, 1891, bearing the well-known signatures of Sir John Williams and Dr. Champneys. Every sentence will well repay perusal. I quote a few : "Perimetritis is probably the very commonest of all the serious diseases of women. It is also perfectly certain that the great majority of cases get quite well without any operation. We are far from denying that exceptional cases call for surgical procedures, or that cases of prolonged suppuration in the pelvis are properly treated by the application to them of ordinary surgical principles. But this wholesale resort to a mutilating operation, advocated by several speakers at these discussions, calls for serious consideration by the profession. . . . A plea for patience is to be found in the declaration of the operators that the full benefits of the operation are not felt for months or years after. If the operator would exercise this patience before the operation there might be less need for its exercise by the patient after the operation."

³ *Syst. of Gyn.*, Allbutt and Playfair, 1896, p. 514.

(a) *Operation during Acute Attack* It is not often that surgical interference is called for during an acute attack. The difficulty and more especially the danger of the operation is increased during this stage. Moreover, the advisability of treating the inflammation when acute by rest is shown by the generally good results obtained. Even if pus is suspected the surgeon should not be in too great a hurry to operate. One well-defined indication for interference during the acute attack has been laid stress on by Mr Cullingworth and that is the accumulation of fluid more especially if it be purulent in sufficient amount to distend Douglas's pouch and encroach on the vagina and rectum. Here "there can be no hesitation as to the propriety of making an opening through the vaginal roof. Such timely interference will not only afford immediate relief to the more urgent symptoms but will prevent the bursting of an abscess into the rectum."

(b) *Recurrent Attacks* A history of recurrent attacks of peritonitis almost invariably means the presence of pus. If with this history the patient has a swelling which has attained such dimensions as to make it fairly certain that in the midst of it there is either an occluded and distended Fallopian tube or an ovary enlarged by cystic growth the indications for the removal of the disease are perfectly clear.

(c) *The Class of Life* to which the patient belongs must be considered. A woman who has to earn her living cannot afford to submit to prolonged treatment by rest; if by operation she can secure a more rapid recovery.

(d) *Persistence of Symptoms after Acute Attack* In most cases with rest and appropriate treatment the inflammatory mass subsides, the pain disappears, and the patient is restored to health. It occasionally happens however that the symptoms persist and unless some relief is afforded the patient there is danger that she will drift into a condition of chronic invalidism and become unfit for any of the ordinary vocations of life. These cases present many points of difficulty and the treatment to be adopted must depend upon the existing condition. Should it be found that the inflammatory mass instead of subsiding persists the advisability of operating will have to be considered. But before resorting to an operation that involves removal of tubes and ovaries the question of how long expectant treatment should be persevered in presents itself. The class of life of the patient as a factor to be taken into consideration has already been mentioned. Mr Herman in answering this question gives the following practical advice:

Most cases will get well within two months but I have seen expectant treatment followed out for two months without relief and then the patient has begun to improve. I therefore think that three months is the minimum which in doubtful cases should be considered a fair trial of expectant treatment. This is only a statement as to most cases not a rule to be applied to every case.¹ On the other hand the inflammatory mass may have subsided as the result of treatment but pain persists and we find on examination that the pelvic organs are displaced and fixed by adhesions. Under these circumstances greater patience must be exercised and the necessity for removal of the appendages most carefully considered before such a method of treatment is adopted. In some of these cases a conservative operation may be advantageously practised and proceedings

¹ *Diseases of Women* p. 240

sanctioned such operations where the appendages were sound. I have agreed thrice to these operations in epilepsy with such pelvic disease as of itself would justify oophorectomy. In all three, after some delay, the fits returned, and were in no way permanently aided.¹

(3) *Osteomalacia* The removal of the ovaries in the treatment of this disease has been performed a number of times since it was suggested by Professor Fehling of Bâle, in 1887, and appears to have met with signal success, the course of the disease being arrested and the patients restored to active life.¹

THE OPERATION

(1) *When Appendages are not Inflamed or Adherent* In cases in which both ovary and tube are to be removed, one ligature passed through the broad ligament on a pedicle needle embraces the isthmus of the tube and the ovarian ligament close to the cornu uteri and secures the uterine vessels. A second one passed through the broad ligament is tied near the pelvic brim over the infundibulo-pelvic ligament securing the ovarian artery and veins. The tube and ovary are then removed between these two ligatures, any bleeding point in the broad ligament that may have escaped being picked up by forceps and tied. Where the tube alone is removed, as in cases of sterilisation following Cesarean section, the tube is picked up, and, a double threaded pedicle needle being passed through the broad ligament, one strand is tied round the tube close to its uterine attachment, the other between the fimbriated extremity of the tube and the ovary.

(2) *Removal of Appendages when they are Inflamed and Adherent* This is an operation that may present many difficulties in its carrying out. Whilst the sense of touch is relied on mainly for the separation of adhesions, the operation will be much facilitated for those who have less experience of pelvic surgery by bringing into play the sense of sight. For this purpose the patient should be placed in the Trendelenburg position, which affords a better view of the pelvic viscera.

Abdominal Incision An incision is made in the median line and carried well down to the pubes. The steps of this part of the operation are similar to those described in ovariectomy. On reaching the peritoneum care must be taken in opening the abdominal cavity, and the operator should bear in mind the possibility of adhesions existing between the omentum or intestines and the wall. The peritoneum is picked up and rolled between the finger and thumb, and, the absence of intestine being noted, is incised, when the viscera at once fall away from the parietes. *Omentum or intestines found adherent to the abdominal wall must be carefully separated by means of the fingers.*

Adhesions The condition existing should then be carefully ascertained and the first thing likely to demand attention is adherent omentum. This is frequently found covering in and adherent to the pelvic viscera, and it may also be much thickened by inflammation. It should be freed carefully from its attachments to the pelvic organs with the fingers, care being taken not to injure intestines or bladder. Any bleeding points should be at once secured. If much difficulty exists in freeing the omen

¹ Bland Sutton *loc. supra cit.*, p. 384

tum or in determining its exact relationship to other parts, it had better be ligatured and divided, the lower attached portion being dealt with later. In any case it is better to ligature and remove portions of omentum much thickened by inflammatory changes. If intestines are adherent they must be separated with great care, and it is in this stage of the operation that the Trendelenburg posture will be found of great assistance. The bowel, more especially after the separation of firm adhesions, should be carefully inspected, and any damage to the walls at once repaired. All adhesions existing between the intestines and omentum on the one hand, and the pelvic viscera on the other, having been freed, the abdominal organs are pushed back towards the diaphragm and maintained in position with a gauze pad. There may be some difficulty in doing so if the abdominal walls are rigid and the patient not fully under the anæsthetic. A little patience, however, will, as a rule, allow of the viscera being pushed up out of the way, so as to enable the operator to obtain a view of the pelvic contents.

Enucleation of Appendages. The operator is now in a position to set about freeing the adherent appendages. As far as is possible the condition present is ascertained by sense of sight as well as that of touch, the position of the uterus located, and the extent and fixity of the mass, formed by one or both appendages, noted. The matted tube and ovary form a tumour lying to the back of the uterus and broad ligament in the lateral fossa or Douglas's pouch, and the broad ligament is drawn over the front of the mass. The first step in enucleation is the separation of the mass from its posterior connections and from the opposite appendages, if inflamed. To effect this, the hand, with the palmar surface forward, is passed down in the hollow of the sacrum behind the mass, carefully separating with the tips of the fingers the adhesions that fix it in this situation. Working down in this way, the lower part of the mass is reached. The next step is its separation from the back of the broad ligament to which it is fixed, and which effectually prevents the tube being drawn up into the wound. Enucleation is consequently continued from below upwards with the tips of the fingers inserted between the mass and the back of the broad ligament. In this way it is gradually freed from all its connections.

Removal of Diseased Parts. The affected parts are now drawn well up through the abdominal incision, and a suitable point in the broad ligament chosen for transfixion. A blunt pedicle needle with a double ligature is then passed through the broad ligament, and the loop divided. Each ligature is then tied separately, one round the Fallopian tube close to the uterine cornu, the other round the free upper border of the broad ligament, and, a pair of forceps being applied to the tube just beyond the ligature, the diseased parts are cut away. There is often much inflammatory thickening of the broad ligament. In this case it will be found necessary to tie the round ligament in three or four separate sections.

The cut end of the tube held in the forceps is next brought into view and carefully wiped with 1-1000 perchloride of mercury solution, to obviate the risk of subsequent infection from the cut end. Before allowing the stump to fall back into the pelvis, the parts are carefully examined for bleeding-points, which should be seized with forceps or else underrun. Care should be exercised in the application of forceps in the pelvis lest a

portion of the rectal wall be nipped and its vitality so affected that it subsequently sloughs

Treatment of Tube when Distended If the tube is found to be distended with pus or other fluid it is better if possible to remove it without previously emptying it. This is recommended on account of the greater ease of dealing with a distended tube than one empty and collapsed. Greater care must however be exercised in the separation of adhesions and the parts packed round with gauze or sponges to prevent as far as possible the spread of infective material if the tube ruptures as it may very possibly do in the course of manipulation. Should rupture occur the fluid must be removed as rapidly as possible all infected sponges and swabs taken away and the parts thoroughly cleansed.

In cases of double pyo-salpinx the ovaries are frequently so involved that their complete removal becomes inevitable. Under these circumstances it is better to remove the body of the uterus as well a procedure that does not add greatly to the length of the operation or appreciably to its risk. The organ is probably infected as well as the tubes and besides being functionless may be the source of further trouble. There is often very free oozing from the back of the uterus and this is arrested much more rapidly by removal of the organ than by other means the duration of the operation being in fact often considerably diminished by this procedure. Its removal further facilitates drainage when this is called for.

Hæmorrhage Oozing from large raw surfaces is sometimes free but generally yields to pressure exercised by sponges in the course of the operation. Should it still persist and no obvious bleeding point be visible at the end of the operation the pelvis should be packed firmly with strips of gauze the ends of which are left out of the lower part of the abdominal incision or carried through an opening in the vaginal vault. The strips should be removed at the end of twenty four hours.

Drainage will be called for more often in the case of pelvic inflammation than of ovarian tumours. The following may be regarded as indications for its employment.

(1) When in the course of removal a pyo-salpinx or abscess cavity has ruptured and soiled surrounding parts.

(2) When the bowel has been injured in the course of the operation. Damage to the small intestine can generally be repaired without risk of subsequent leakage. Injury to the rectum cannot be so readily dealt with and it may be impossible for the operator to gain such access to the damaged parts as will enable him to repair the lesion. To prevent general infection of the peritoneal cavity as the result of leakage from the bowel he will have to depend on careful gauze packing.

(3) When the operation is incomplete. Firmness of adhesions and danger of injury to viscera will sometimes lead the surgeon to leave his operation unfinished rather than subject his patient to unusual risk. He has probably exposed in the course of his manipulations infected areas such as a pyo-salpinx or a pelvic abscess. Under these circumstances he will remove such diseased structures as is found possible and provide free drainage by means of gauze strips for the infected parts left behind.

Conservative Surgery By this term is meant the preservation of such organs or parts of organs as are not diseased or not beyond the

power of recovery. This, which is the general principle underlying all true surgery, receives special significance in its application to the pelvic organs on account of the importance of the latter in securing the happiness and well-being of the individual. This applies more especially to the ovaries, which are not only essential to the functions of menstruation and child-bearing, but which exercise—probably by means of some internal secretion—a wide influence over nutritive processes in general. That every effort should be made to preserve a portion at least of one of these organs is not disputed at the present time; the only question is how far one is justified by one's attempts at conservatism in subjecting the patient to increased risks of recurrence of disease and further operation.

An important step was made in conservative surgery when it was recognised that disease limited to the appendages of one side did not necessarily mean the removal of the organs on both. A further advance was marked by the recognition that certain conditions, which at one time were thought to be pathological, were not diseases at all.

The cystic ovary is a case in point. Though a definite pathological condition does exist in which the ovary is the seat of numerous small cysts, the mere presence of these does not necessarily constitute an abnormal state of the organ, nor do they justify its removal.

A further reason advanced for the practice of conservatism lies in the fact that portions of organs left behind are capable of performing the functions of the entire organ. It has been shown clinically that the stump of an amputated tube may convey an ovum to the uterus, which will then pass through the developmental changes of normal pregnancy.¹

Dr. Kelly² has recorded a case in which pregnancy followed an operation involving the removal of one tube and the opposite ovary, and where the transmission of the ovum was effected by the tube on the side opposite to that of the ovary. Similar cases have been recorded in which pregnancy has followed operations involving partial removal of the appendages. Whilst such an event may not be very common, the mere fact that it can occur constitutes a further reason for exercising such conservatism as is possible in dealing with the pelvic organs.

The capacity for repair shown by inflamed pelvic organs and the powers of absorption of the peritoneal sac in the case of large inflammatory exudates are well-established facts. A similar course of events is known to all surgeons in the case of the vermiform appendix. This power of regeneration is a point telling in two ways, for whilst it will encourage the operator to sacrifice as little as possible of the organs he is dealing with, it is also an argument in favour of rest and expectant treatment.

There are certain conditions other than disease of the tubes and ovaries demanding operation in which there can be no doubt as to the advisability of leaving the ovaries or as much of them as can be safely preserved. Hysterectomy for fibroids is a case in point, where one or both ovaries should be left when possible. A further example is seen in parovarian cysts, which may be shelled out sometimes from the broad ligament without sacrificing tube or ovary.

When we come to disease of the ovary itself, it is especially in non-

¹ B. F. Baer, *Ann. of Gyn. and Ped.*, January, 1894.

² *Loc. cit.*, p. 188.

inflammatory affections that an attempt may be made to save a portion of the organ. Such conditions as cysts due to enlargement of Graafian follicles or corpora lutea may be dealt with on this principle the cyst being shelled out or a wedge shaped portion of the ovary being removed. In the case of dermoids and the cystomata the ovarian tissue is as a rule, so involved that an attempt to save a part of it will not often be found possible. Even when as occasionally happens some of the ovarian tissue remains unaffected the advisability of trying to preserve it is open to question on account of the risk of leaving behind sufficient of the tumour to lead to a recurrence. Nor does it seem improbable that the remaining portion of the ovary is liable to a similar cystic change. The chief justification for saving a part of the organ would be in the fact that the opposite ovary either required removal or had already been removed.

It is in dealing with inflammatory conditions of the appendages that the widest difference of opinion with regard to conservatism exists. It was the practice at one time if the appendages on one side were diseased to remove those on the other side even if found healthy. This was done more especially in those cases in which the tubes were the seat of suppuration. The late Mr Greig Smith¹ said: "The removal of the appendages on one side only for suppurative disease was tried by Tait but given up on account of the large number of recurrences or relapses. Other surgeons have had similar experiences and the rule in all cases of suppurative diseases of the appendages now is that if one set is removed so also should be the other."

In spite of the risks of recurrence modern opinion inclines strongly to the preservation of healthy appendages and as the interior of the uterus is the source of infection in most cases the more rational treatment is to attend carefully to this and thus prevent the extension of inflammation so far as is possible to the sound appendages. Before deciding to leave them they should be carefully examined. Should pus be found to exude from the end of the tube it should be removed. Such a high authority as Dr Howard Kelly² recommends that under certain circumstances the contents of the tube should be squeezed out and its interior washed out with saline solution and then sterilised with 1 in 5000 corrosive sublimate solution. It is difficult to believe that the tube can be effectually sterilised in this way and its preservation would seem to invite reinfection of the peritoneal cavity. Until more evidence is forthcoming with regard to this procedure it appears unsafe to recommend it for general adoption. On the subject of adhesions Dr Kelly has laid it down as a rule that these do not in themselves constitute a reason for the removal of organs. The mere presence of adhesions does not imply that the organs are beyond the power of recovery and in fact there is plenty of clinical evidence to the contrary. It has already been mentioned that in some cases the persistence of symptoms is due rather to adhesions binding down the pelvic organs in abnormal positions than to the presence of any source of inflammation. Under these circumstances operative proceedings may be limited to the separation of adhesions and the fixation of organs in better position. Dr Kelly has laid stress on the importance of

¹ *Syst of Gyn*, Allbutt and Playfair 1896 p 910

² *Loc cit*, vol II, p 186

not only freeing the organs from surrounding parts, but also of liberating any kinks in the tube, a condition that may render the patient liable to tubal pregnancy.

Whilst treatment limited to the freeing of organs may be followed in those cases in which the inflammation has subsided, it should not be adopted when they are still inflamed. The separation of adhesions without removal of the cause is certain to be followed by the formation of fresh ones, besides breaking down the barrier that limits the spread of infection.

The question may arise as to whether the Fallopian tube should be preserved when removal of the corresponding ovary is found necessary.

In inflammatory conditions of the appendages, it is uncommon to find a case in which the ovary requires removal and the tube is found in a healthy state. Moreover, the tube is useless without the ovary, and as the late Mr. Greig Smith has pointed out, the removal of the latter will probably cause kinking of the tube. Consequently, if the ovary is removed, it is usually safer to remove the tube also.¹ It might be left if operative measures have resulted in the preservation of the opposite ovary, but removal of the corresponding tube. In Dr. Kelly's case, quoted above, pregnancy followed such an operation, leaving one ovary and the opposite tube.

Those conditions have been pointed out in which the practice of conservative surgery may be safely advised. But there are certain operations more open to debate, such as the washing out of tubes containing pus, the amputation or resection of diseased tubes, and the opening of closed tubes. In the hands of the chief advocates of conservatism these procedures have met with results that may be regarded as encouraging, but, with our present information, they are not operations that can be recommended for general adoption.

¹ *Loc. supra cit.*, p. 909.

CHAPTER XXXI

OPERATIONS ON THE UTERUS

FIBROIDS, CANCER OF THE UTERUS CÆSAREAN SECTION. ECTOPIC GESTATION

OPERATIONS FOR FIBROIDS

Indications for Operation. The mere presence of a myoma in the uterus does not necessitate operation. Surgical treatment should be adopted only when the tumour is giving rise to symptoms which threaten life, impair health, or prevent the patient from enjoying a reasonably comfortable and active existence. The principal symptoms which justify operation are considered in the following paragraphs.

(1) **Hæmorrhage.** Increasingly profuse hæmorrhage at the menstrual periods is the symptom which most commonly compels a patient to seek medical advice. The amount lost and its effect on the woman's health, the age of the patient and her mode of life are all factors to be taken into consideration. In women about forty years of age operation is often deferred in the hope that the menopause will cause not only a cessation of bleeding, but will lead to a shrinking of the tumour. This hope is but seldom justified. The fact that the climacteric is generally delayed, it may be until after fifty years of age, must be remembered. If the monthly loss is sufficiently excessive to produce well marked anæmia, in spite of milder measures of treatment the advisability of immediate operation must be urged. Too many women are allowed to reach a stage of profound secondary anæmia before relief is sought by operation.

(2) **Pressure Symptoms.** These are most marked in the case of medium sized tumours impacted in the pelvis. The most common symptom is frequent or difficult micturition. There may also be trouble in keeping the bowels open, owing to pressure on the rectum. The ureters may be pressed on, and hydro nephrosis or pyelo nephritis result. These symptoms are most marked just before the onset of the menstrual flow, when the tumour is swollen as a consequence of the natural engorgement of the organs.

Pain in association with fibroids is due not only to pressure on nerves and neighbouring organs, but also to attacks of peritonitis and inflammation of appendages. Adhesions produced thereby may seriously complicate hysterectomy.

(3) **Great Size.** A large tumour in the abdomen may not necessarily threaten life, but may be a source of grave inconvenience and discomfort. It interferes with the return of blood from the lower limbs, and so causes œdema, it presses on the stomach and impedes digestion, it limits the movements of the diaphragm, and so interferes with respiration, and leads to a condition of general ill health. At the present day it is exceptional for surgical treatment to be withheld until a tumour has reached

an excessive size, but the successful removal was recently recorded of a myomatous uterus which weighed over forty-seven pounds.¹ Undoubtedly hysterectomy for a tumour of great bulk entails somewhat greater risk than an operation for a fibroid of moderate size, but the benefits conferred are correspondingly increased. A well-advised patient will, therefore, welcome relief by operation.

(4) **Rapid Growth of the Tumour.** If at intervals of a few months the tumour is found to be markedly increasing in size, the question of its removal will have to be considered. Very rapid enlargement is usually due to secondary changes occurring in it, such as cedema, or cystic

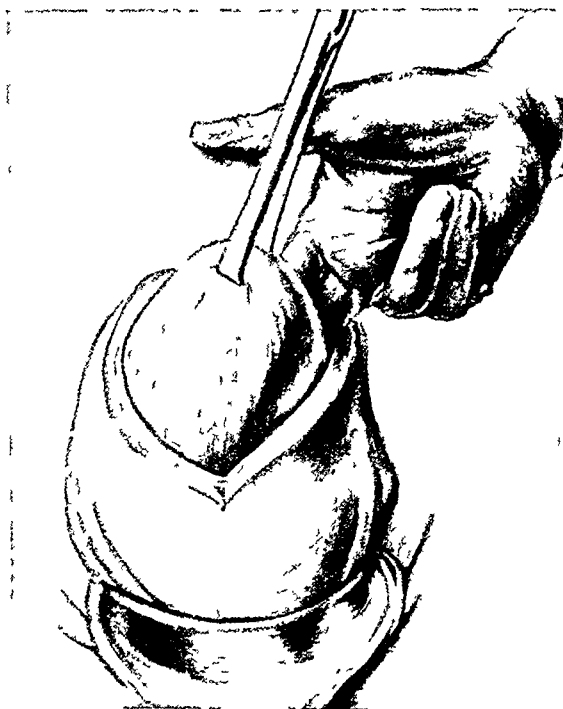


FIG. 458 —Myomectomy. Enucleation of fibro-myoma.

degeneration. A sarcomatous change will also be responsible for a rapid growth, but is of rare occurrence.

(5) **Complications** due to associated inflammatory disease of the appendages and peritoneum, tumours of the ovary, cancer of the uterus, will call for operative interference.

Operative Treatment. The surgical treatment of fibroids comprises the following methods :

- (i) Myomectomy.
- (ii) Subtotal hysterectomy.
- (iii) Total hysterectomy.

(i) **Myomectomy.** Individual fibroid tumours may be enucleated from the musculature of the uterus abdominally or per vaginam. Myo-

¹ T. G. Stevens, *Journal of Obstetrics and Gynaecology of Brit. Empire*, Vol. 32, No. 4, 1925.

mectomy by the vaginal route is one of the most ancient of surgical operations but its present-day use should be restricted to the removal of pedunculated tumours or of small submucous myomata easily accessible without division of the cervical canal

Abdominal myomectomy has a wide field of usefulness it is the ideal procedure when conservation of the womb is of great importance as in a young woman or one very desirous of children In the hands of certain gynaecologists it has become the operation of choice but even under the best conditions an operative mortality attaches to myomectomy which compares unfavourably with that of simple hysterectomy Moreover function is preserved at a small but definite risk of recurrence of symptoms and of post operative complications such as intestinal obstruction The surgeon who esteems a sound therapeutic result above a surgical triumph will therefore perform myomectomy only when special circumstances render it desirable and when the tumours are few and of moderate size He should always obtain consent to proceed to a hysterectomy if his judgment demands the more radical procedure

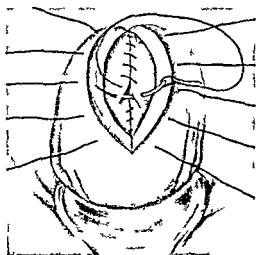


Fig 400 Myomectomy Series of deep sutures obliterating the cavity

The Operation The abdomen is opened by a median or paramedian incision starting just below the umbilicus and extending well down to the pubes Care should be taken in dividing the peritoneum not to injure the bladder which is occasionally drawn up by the tumour A hand introduced into the abdomen now carefully investigates the condition present

Having decided that myomectomy is feasible the surgeon should next secure good exposure of the uterus utilising for this purpose the raised pelvis position a fixed abdominal retractor and efficient packing to keep the intestines clear of the field of operation The situation of the tumours whether in the anterior or posterior wall of the uterus should then be ascertained by inspection and systematic palpation of the uterus as it is desirable to avoid traversing the endometrial cavity

The incision made over the convexity of the fibroid should be in the nature of a stab into its substance so as to incise the immediate capsule of condensed muscular tissue When the proper layer has been discovered a finger inserted between it and the tumour will be found to be the best instrument with which to effect complete enucleation As separation proceeds the tumour is partly dragged out of its bed by means of a tissue forceps and partly squeezed out by pressure applied between thumb and fingers Any vascular bands are clamped and subsequently

ligatured, but oozing from the deep cavity which results is, in the main, most effectively controlled by a series of deep sutures which are passed so as to obliterate the space. When bleeding from the incised muscle edges is profuse, mattress sutures running from the peritoneal surface of one side to the other may be necessary in order to secure perfect hæmostasis. The edges of the incision are trimmed of redundant tissue and are then united by a continuous seromuscular stitch.

Single large myomata, or possibly two or three, can be dealt with in this manner, but it is unwise to cover the surface of the uterus with sutured incisions in view of the danger of intestinal adhesions.

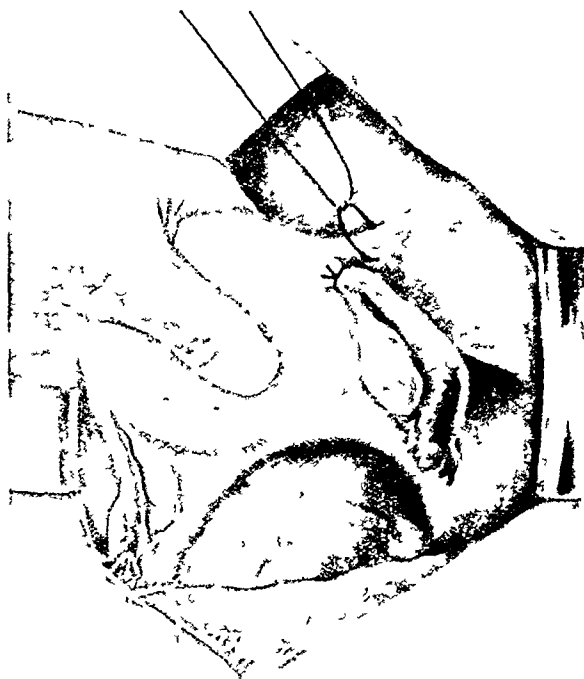


FIG 460 Subtotal hysterectomy Ligatures passed round the round ligament and the Fallopian tube and ovarian ligament.

Mr. Bonney¹ avoids multiple sutured wounds on the surface of the uterus by extracting many fibroids through a single incision on the anterior surface of the uterus. He adopts an ingenious system of tunnelling the uterine musculature in all directions, and has devised clamps to compress temporarily the uterine and ovarian arteries. Most surgeons are sceptical of the value of an organ so extensively mutilated.

(ii) **Subtotal Hysterectomy.** Supravaginal amputation of the uterus through its cervix was first introduced by Baer, of Philadelphia, in 1892. It rapidly became the popular method of treating fibroids, displacing total hysterectomy and all forms of partial hysterectomy depending upon mechanical constriction.

As practised to-day subtotal hysterectomy ranks as one of the most satisfactory operations in surgery both as regards its immediate and

¹ Bonney, *Lancet*, 1925, ii, 1060.

remote results Two criticisms have been levelled against the operation as a routine measure The first is that the isolated cervix is prone to become the site of malignant change, there is little evidence to support this contention The second objection is that an unsuspected carcinoma may be associated with fibroids of the body of the uterus, this danger is met if an assistant is instructed to open up the body of the uterus as soon as it has been removed

Total ablation should be considered when the cervix is lacerated and hypertrophied with an infected canal a source of discharge

The Operation After the abdomen has been opened by an incision



FIG 461 Subtotal hysterectomy Ligatures passed round free edge of broad ligament and round ligament for removal of appendages

proportionate in length to the size of the tumour to be removed the surgeon's first step should be to pass his hand into the abdomen to make a careful examination of the conditions with which he has to deal Adhesions on the front of the tumour are very rarely met with When they exist they will be found behind and are almost invariably the result of salpingitis If the uterus is large and the adhesions are dense more particularly when a pyosalpinx of long standing exists the difficulties of the operation are likely to be considerably increased All adhesions must be broken down and the tubes freed before the removal of the uterus can be carried out In the simpler cases the tumour is brought out of the wound but when this cannot be done it will be necessary to carry out the earlier stages of the operation with the uterus in the abdomen

Division of Broad Ligaments The uterus having been drawn out of the abdomen, the operator carefully examines the broad ligaments and

appendages on each side, and decides whether he will leave one or both ovaries, or whether he will remove them both. When possible, one at least should be saved, exception being made in those cases in which they are found diseased, or when it is found impossible to leave them, or the patient has reached the menopause. The surgeon, after carefully examining both sides, chooses that which can most easily be dealt with, and, seizing the upper part of the broad ligament, passes through it, at a point free from vessels, a blunt pedicle-needle threaded with silk or catgut. The exact point of perforation will depend upon whether the ovary is to be removed or not; in the former case the ligature will be carried

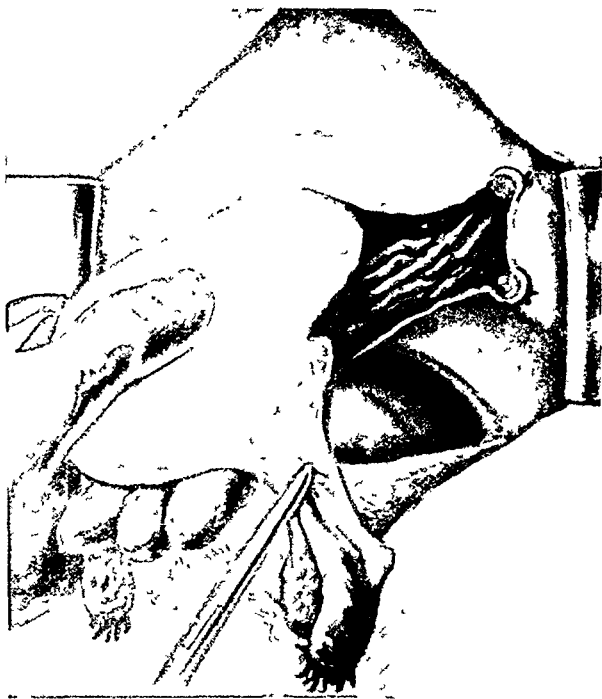


FIG. 462. Subtotal hysterectomy. Broad ligament divided.

round the free edge of the broad ligament; in the latter it will include the Fallopian tube.

This ligature, which secures the ovarian artery, is then firmly tied, and that portion of the broad ligament next the tumour being secured by means of forceps, the part intervening between the ligature and the forceps is divided (Fig. 461). A second ligature is passed through the broad ligament of the same side, lower down, including the round ligament, and firmly tied; the proximal portion of the broad ligament is clamped, and the part between forceps and ligature divided. In most cases these two ligatures will be found sufficient, but more can be applied in the same way if required. The use of forceps for clamping the proximal part of the ligament, as described above, rather than ligatures, will be found to effect a saving of time. The opposite side is then dealt with in the same way.

Formation of Anterior Flap The next step in the operation is the reflection of a flap of peritoneum and the bladder from the front of the uterus. An incision is made through the peritoneum covering the front of the uterus from side to side, about an inch above the line of attachment of the bladder, the position of which should be carefully ascertained. It should be carried across to join at each extremity the lower end of the cuts in the broad ligaments. The bladder is then separated from the uterus by means of the finger any firmer bands (and these are met with especially in the median line) being divided with scissors. Care should be taken in this separation as the bladder is sometimes much thinned by stretching and it does not require much force to push the finger through into its interior. Should this accident happen the opening must at once be closed with sutures. By the reflection of the anterior flap some loose cellular tissue on each side of the neck of the myomatous uterus is exposed, and in this there may be felt pulsating and sometimes seen, the uterine artery.

Ligature of Uterine Artery. The position of the artery is now carefully defined on one side, and a ligature threaded on a pedicle needle is passed through the cellular tissue between the artery and the uterus and just below the point at which the division through the uterus is to be effected. A pair of Spencer Wells forceps are now applied so as to include the artery a little above the ligature and the latter is firmly tied. The tissues including the uterine artery are then divided between the ligature below and the forceps above and if the ligature has been properly applied there will be no bleeding. If the artery has not been secured it will spurt on division and should be promptly seized with forceps and tied. The same procedure is adopted on the opposite side. It may happen that in the passage of the pedicle needle round the uterine artery hæmorrhage at times so free as to be alarming results. This is due to injury to veins which may be of great size. The best way of avoiding this is to carry the ligature as close as possible to the uterus. When it occurs clamp at once the uterine vessels above the ligature where they lie close against the uterine wall. If the bleeding is taking place from the veins returning from the tumour it will be arrested by these means. If it continues and the vessel cannot be seen get an assistant to press with a plug in the neighbourhood of the bleeding to control it if possible quickly clamp or ligature the uterine vessels on each side cut through the cervix and remove the tumour and then search for the bleeding vessel. It will often be found on removal of the uterus that the bleeding has ceased showing that the hæmorrhage was coming from the tumour.

Removal of Uterus A point has now been reached at which the blood supply has been secured and nothing is left keeping the enlarged uterus in position but the narrow neck below. The only remaining step is to divide this latter. The intestines being kept out of the way, the left hand is passed down behind the neck to prevent the possibility of injury to bowel and the pedicle is divided with knife or scissors just above the point at which the uterine arteries are secured.

The division of the pedicle is effected by making a V shaped incision transversely across the cervix. The anterior and posterior segments so formed are then approximated by two or three stitches of stout catgut so as to close the cervical canal and at the same time to stop all bleeding

from the cut surfaces. The ends of the sutures are left long, as, in the grasp of an artery forceps, they give a convenient hold on the stump during the subsequent peritonealisation of the raw area. The divided edges of the broad ligament on one side are first sewn together. The anterior flap of peritoneum is then drawn over the stump, and its free border sutured to the cut edge of peritoneum at the back of the stump, the operation being completed by sewing together the two edges of the remaining broad ligament.

Some Difficulties met with in Hysterectomy for Fibroids. Although the operation for a myomatous uterus as described above may be straight-

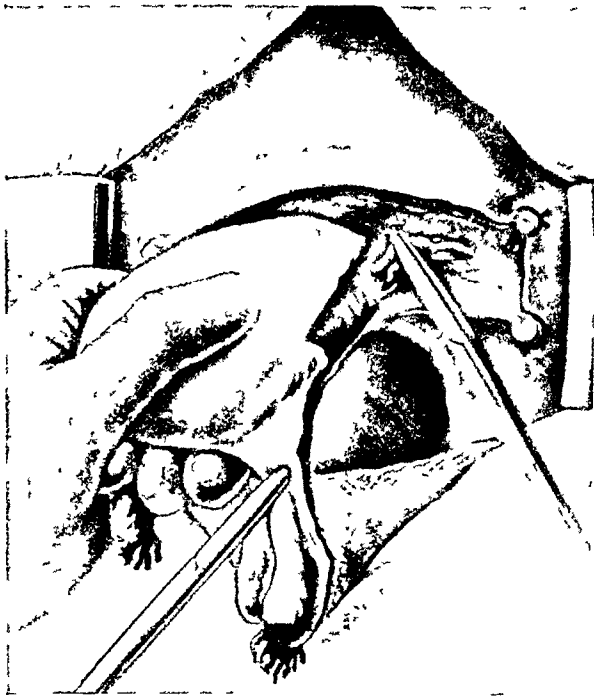


FIG 463 Subtotal hysterectomy. Ligation of the uterine vessels

forward and comparatively easy, cases are frequently met with which will tax the resources of the surgeon. Few operations call for greater variety of treatment depending upon the variations in the size and situation of the tumours. A large tumour is not necessarily difficult to remove, a smaller one may present considerable difficulties. It may be said roughly that the ease of the operation will depend upon the facility with which the myomatous uterus can be drawn up out of the pelvis, and the uterine vessels reached.

One form of difficulty not infrequently met with is due to a fibromyoma growing to one side between the layers of the broad ligament, expanding this together with the Fallopian tube and ovary over its surface. It may even spread out the mesosigmoid, so that the bowel is closely applied to its surface. Such a tumour cannot be drawn up out of the pelvis. The Fallopian tube and round ligament having been picked up,

ligatured and divided the opening thus made in the peritoneum is sufficiently enlarged to allow of the tumour being shelled out. The peritoneum may contain large veins and care should be taken not to injure them, ligatures or clumps being used as required. A careful watch should also be kept for the ureter which may be much displaced. The tumour may then be drawn up and a search made for the uterine vessels. If the fibroid cannot be drawn up the procedure adopted by Dr Howard Kelly may be followed. Instead of tying and dividing the broad ligaments on both sides before severing the pedicle he works across the pelvis from one side to the other dividing first one broad ligament then the pedicle and

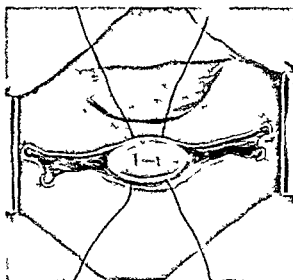


FIG. 464. Subtotal hysterectomy. Cervical stump left after removal of body of uterus. Sutures shown in position for bringing together the edges of the stump.

dealing last of all with the other broad ligament. The stages of the operation as described by him are shortly as follows.¹

(a) **Ligation of the Ovarian Vessels and Round Ligament of one side, usually the left.** In a woman under forty years of age he considers it better to leave both ovaries in the pelvis with or without the uterine tubes. The broad ligament is divided between two sets of ligatures or between forceps on the proximal and ligatures on the distal side as previously described.

(b) **Detachment of the Vesico-uterine Fold of Peritoneum.** The uterus being drawn back the anterior loose peritoneal fold along the curved line of the utero-vesical reflection is cut through from round ligament to round ligament. As the bladder is raised the loose cellular tissue beneath it is exposed and it may be still further freed by a rapid dissection with knife or scissors. The separation of the bladder is completed by pushing it well down with a sponge firmly compressed in sponge forceps until the cervix is bared almost down to the vaginal junction.

¹ *Loc. supra cit.*

(c) **Ligation of the Uterine Vessels of the same side.** These vessels are now securely tied close to the cervix by a silk ligature on a curved needle passed close to the cervical tissue, but not entering it.

(d) **Amputation of Uterus in Cervical Portion.** The uterus is now drawn to the other side, and the uterine vessels are divided from 6–10 mm. above the ligature, an assistant being ready with artery-forceps to grasp any bleeding vessel left by chance out of the ligature. The uterus is now completely divided in its cervical portion, at a point just above the vaginal junction, and in such a way as to leave a cup-shaped pedicle. It is a good plan, when the cervix is nearly divided, to cut upward for one or two centimetres so as to leave behind a thin shell of cervical tissue, and expose

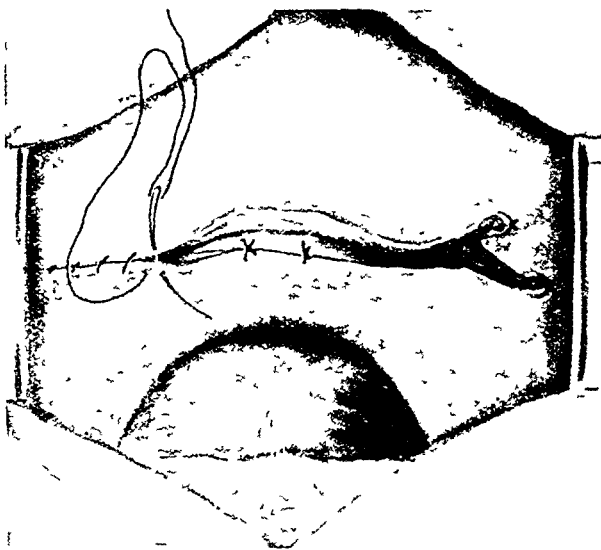


FIG. 465. Subtotal hysterectomy. Closing the peritoneum over the stump.

the opposite uterine vessels at a higher level, when it is much easier to tie them without risk of including the ureter.

(e) **Clamping the Uterine Vessels of opposite side, the Round Ligament, and the Ovarian Vessels, followed by Removal of the Tumour.** As the uterus is drawn up and rolled over on to its side, the uterine vessels come into view; these are seized in clamp forceps and divided. The uterus is rolled over still more till the round ligament is seen. This is clamped and divided, and is followed by similar treatment of the ovarian vessels. The whole mass is thus freed and taken away.

(f) **Application of Ligatures in place of Forceps.** The parts now held in forceps (the ovarian vessels, the round ligament, and the uterine vessels) are successively tied with firm silk ligatures and the forceps removed.

(g) **Suturing the Cervical Stump.** The stump is carefully examined for any bleeding-points, which should be tied. It is now closed over the cervical canal by passing from three to five or more catgut sutures in an antero-posterior direction, and tying each one as it is passed. By suturing in this way the cup-shaped pedicle is changed into a transverse

linear wound. Should there be a discharge of pus from the uterus or a muco-purulent plug in the canal this latter should be wiped out with gauze as soon as cut across and afterwards dissected out with a sharp knife and forceps.

(h) **Covering the Wound-area with Peritoneum** The large flap of peritoneum which lies in front of the pedicle is drawn over the stump and sutured to the posterior peritoneum by a continuous suture.

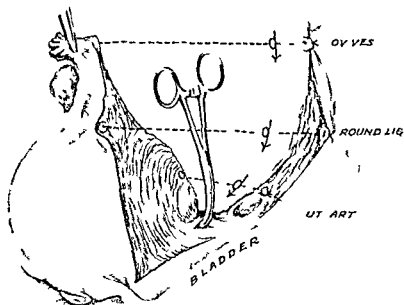


Fig. 466 subtotal hysterectomy (hclh)

This method can be varied to suit the different conditions associated with fibromyomata growing out into the broad ligament and mesosigmoid. The bowel can usually be separated without difficulty. I have only had one case in which it was intimately attached to the tumour and in that case extensive degeneration had taken place so that the tumour was a thin shell containing a fluid yellow detritus.

A tumour growing forward between the cervix and bladder may effectually prevent the uterine vessels from being approached. In this case it must be shelled out from the uterine wall. Cut well down to the tumour through the layer of uterine muscle covering it before attempting to remove it. This may be associated with much bleeding and should in that case be carried out quickly. This method of shelling a tumour out of its capsule may be followed with advantage in other situations in which a fibroid is so placed as to interfere with the progress of the operation.

When a large tumour is situated behind the uterus and below the peritoneum such for example as a fibromyoma in the posterior lip of the cervix instead of attempting first to remove it or to separate it from its connections it will be found better after tying the vessels and dividing the broad ligaments to cut through the cervix from before backwards in

the usual way. All that remains then is to shell out the tumour from the pelvic floor.

(iii) **Total Hysterectomy.** As a routine operation for fibroids, complete removal of the uterus is not to be recommended. It prolongs the operation, and by the opening of the vagina increases the risks of septic infection. It may be called for, though rarely in cases of fibroid tumour or fibrosis of the uterus. When undertaken it is generally for cancer of the uterus. The operation performed for cancer of the cervix is described separately. That now described is confined to the removal of the uterus, and is suitable for certain cases of carcinoma of the body, more particularly when age or infirmities render the more complete operation known as Wertheim's inadvisable. The broad ligaments having been divided and the bladder separated in front from the cervix and upper part of the vagina, the uterine arteries are sought for. In partial hysterectomy these were tied by a ligature passed as close as possible to the uterus. For the complete removal, they must be tied a sufficient distance from the uterus to allow of a pair of Spencer-Wells or clamp forceps being applied between the ligature and the uterus. The position of the ureters below the uterine vessels must be borne in mind, but the risk of including them is not great if the vessels are carefully exposed and are not tied too far out. The vessels being tied on each side and a clamp applied, the tissues between the forceps and the uterus are then divided, and a pair of forceps are applied on each side to include the remaining tissue of the parametrium as far down as the vaginal vault. This again is divided between the forceps and the cervix. The uterus now remains attached only to the vagina. The bladder being sufficiently reflected from the anterior vaginal wall, this latter is divided with scissors in front, and the incision is carried round the vaginal vault so as to detach the uterus completely. Any bleeding vessels in the cut vaginal wall are secured, and the tissues included in the forceps on each side are ligatured and the forceps removed.

With a continuous catgut suture, the cut edges of the peritoneum are then approximated. Having sewn together the two layers of the broad ligament on one side, the anterior peritoneal flap is brought over the vaginal opening and secured to the posterior cut edge of the peritoneum, the operation being completed by the closure of the broad ligament on the remaining side.

CANCER OF THE UTERUS

Carcinoma of the Cervix. For this condition, the uterus has been removed by two routes, the vaginal and the abdominal. The older form of operation by the vaginal route has practically been superseded by the abdominal operation and will not be described.

To determine whether a case is suitable for removal of the uterus. It is not easy in a case of cancer of the cervix to say whether the whole disease can be eradicated, as growth may have extended beyond the limits of the uterus, and yet be inappreciable on the most careful examination.

To determine whether a case is operable, the different routes by which the growth may advance must be carefully borne in mind, and a systematic examination made of each. They are as follows :

(1) The growth may involve the fornices or extend down on to the vaginal walls.

- (2) It may extend forwards and involve the bladder
- (3) It may extend outwards in the broad ligaments
- (4) Or extend backwards in the utero sacral folds and involve the rectum

In examining a case the first thing to be noted is the mobility of the uterus. This may be tested most efficiently by fixing a pair of tenaculum forceps into the cervix and observing whether the organ can be drawn down readily towards the vulva. If there is complete or considerable fixation and wide extension of growth in any of the above mentioned directions the case is inoperable and should be left alone. The cervix should be examined not only digitally but through a speculum and the extent to which the fornices or the walls of the vagina are involved carefully noted. To determine whether extension laterally in the broad ligaments or backwards in the utero sacral folds has taken place the vaginal examination must be supplemented by a rectal one and a search made for any masses or thickening in these situations.

If the uterus is freely movable and can be pulled down to the vulva and there is nothing to be felt in the broad ligaments or utero-sacral folds the case is a favourable one for operation and there are good grounds for hope of permanent relief.

But between the eminently favourable cases and those that are to be regarded as inoperable certain cases are to be met with not infrequently in which there exists an element of doubt as to whether the growth can be entirely removed. On this point Dr Howard Kelly's remarks are worth quoting. In concluding whether or not to operate the patient should in all cases have the benefit of any reasonable doubt and the operator must not be too exacting in restricting his indications. I have operated several times where the disease was found so advanced that there could be no reasonable question but that some portion of it was left behind and this was confirmed by a microscopic examination of the specimen which showed cancer cells right up to the cut edge of the broad ligament and yet one of these patients enjoyed perfect health for five years when the disease reappeared in the glands of the neck another had a local return after three years of good health and two others are living apparently in perfect health three and four years after the operation.¹

In considering this question the influence that repeated losses of blood and continuous septic absorption from the breaking down cancerous mass have on the health of the patient should be borne in mind. If under the circumstances there is reason to think that the uterus can be removed without unusual risk the surgeon is justified in operating after laying the facts of the case fairly before the patient. For recurrence of the disease so long as it does not take place in the vaginal roof will be attended with less pain an absence of hæmorrhage and a relief from the distress dependent on a fetid discharge.

No radical operation should be undertaken if extension of growth has led to involvement of bladder ureters or rectum.

Palliation may be afforded in some inoperable cases by a free scraping away of the growth in the cervix. Whilst considerable benefit follows in some cases in others and especially when the growth is very advanced

¹ *Loc. supra cit.* p. 319

scraping has done more harm than good by hastening communication with the bladder and other organs.

Abdominal Hysterectomy for Carcinoma of the Cervix. Wertheim's Operation. Although the carcinomatous uterus had been removed through the abdominal route by Veit, Freund and others, it is to Wertheim that the credit belongs of having put the operation on a definite and systematic basis, and it is by his name that the operation is now generally described. It has replaced the vaginal route as the regular method for

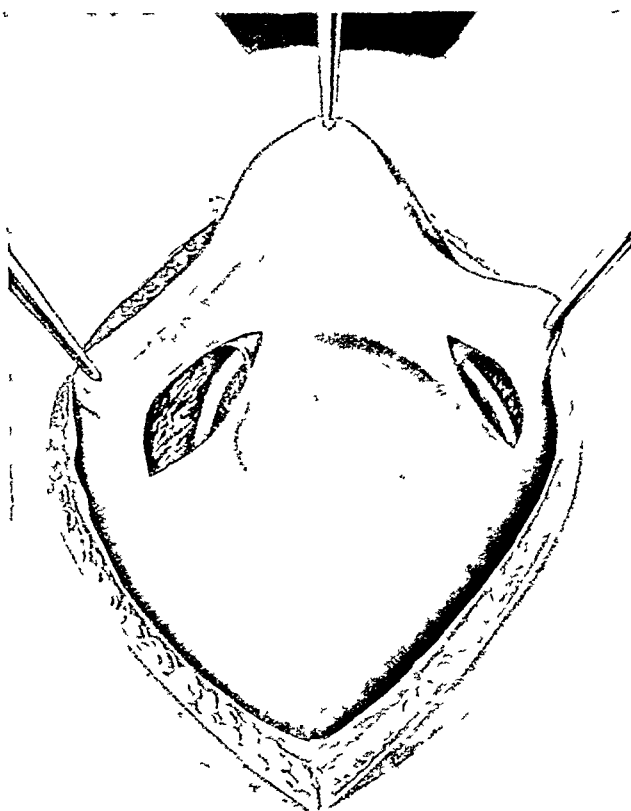


FIG 467. Wertheim's operation Uterus drawn forwards and peritoneum divided, exposing the uterus (after Wertheim).

removal. It has a wider range of utility, many cases that would not be operable by the vaginal route being dealt with successfully through the abdomen. It allows of a freer removal of the growth, and also enables enlarged glands to be sought for and removed.

Preparatory Treatment. When possible, the patients should have preparatory treatment for a week before the operation. They are often run down in health as the result of hæmorrhage and discharge, and a week's rest in bed with generous feeding and vaginal douching will enable them to stand better the operation, which is a severe one. As regards preliminary treatment of the cervix, this will depend on the condition present. Where there is no foul discharge and the growth is firm and

not broken down treatment may be limited to douching. Where foul discharge exists with ulceration of growth or polypoid masses of growth projecting into the vagina an attempt must be made to clean the cervix up as far as possible before operation. This is carried out by means of the curette and cautery either some days beforehand or at the time of operation. The disadvantage of the cautery used beforehand is that it causes sloughs to form with a return of the discharge. I think it better to confine oneself to the curette. The best time would be just before the

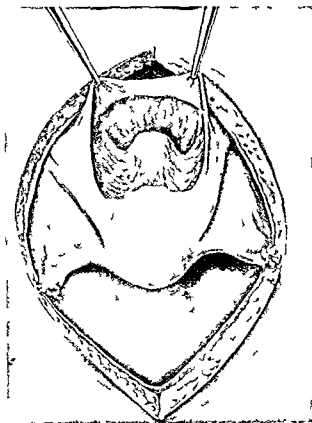


FIG. 463 Wertheim's operation. Peritoneum divided in front and bladder separated from cervix (after Wertheim)

abdominal section is performed were it not that it prolongs the operation. On the whole it would appear to be better to curette and cleanse the cervix a day or two before the operation. Care must be taken that in doing so the scraping is not carried so far as to open up the peritoneal cavity or to injure the bladder. The disadvantage of dealing with the cervix beforehand is that it causes some inflammation in the parametric cellular tissue rendering it more oedematous perhaps causing more difficulty in separating the bladder and ureters and causing the parts to be less easily recognised.

The Operation The patient being placed in the Trendelenburg position an incision is made in the median line. This should be of good

length and carried above the umbilicus. A thorough examination is now made of the pelvic contents, the extent of the growth, the mobility of the uterus, the presence or not of glands. Wide extension of growth or masses of fixed glands will lead the surgeon to discontinue the operation. If any doubt exists as to involvement of the bladder wall, it would be well in the first instance to divide the peritoneum in front of the uterus and see whether the bladder can be separated. If it is found to be infiltrated the peritoneum can be sewn up and the abdominal wound closed.

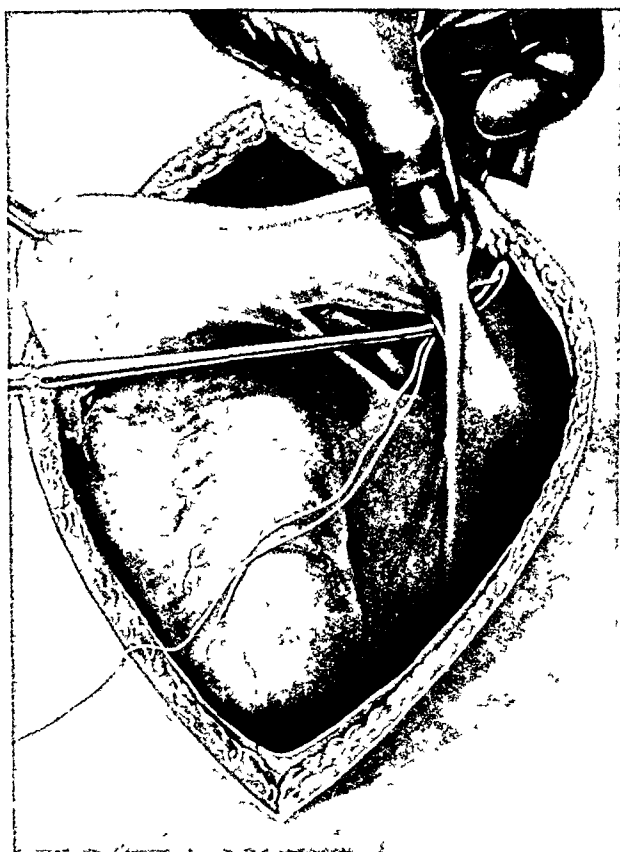


FIG. 469. Wertheim's operation. Ligature being passed round infundibulo-pelvic ligament (after Wertheim).

(1) **Division and Opening of the Broad Ligaments.** The first step in the operation consists in tying the infundibulo-pelvic ligament containing the ovarian vessels and the round ligament. The broad ligament is then divided with scissors and opened up widely with two fingers exposing the parametric tissue.

(2) **Exposing the Ureters.** The ureters are then sought for on the posterior leaf of the broad ligament as they run forward to the side of the cervix. They will be best found by rolling the peritoneum between the finger and thumb. Difficulties will be encountered when salpingitis and pelvic adhesions exist, when the uterus cannot be drawn well up and forwards, when the pelvis is deep and small and when patients are un-

usually stout. This latter complication makes all stages of the operation extremely difficult. They should then be traced forwards to the ureteric canal by the side of the cervix at which site they are crossed by the uterine arteries. They should not be freed all round and so isolated from their vascular supply.

(3) *Separation of the Bladder.* The loose peritoneum on the front of the uterus just above the bladder having been picked up and divided, the bladder is separated from the front of the cervix and upper part of

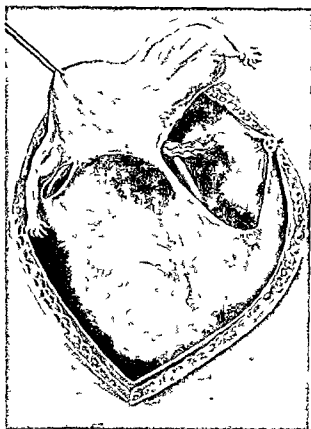


FIG 470 Wertheim's operation. Right broad ligament divided. Uterine vessels exposed crossing ureter (after Wertheim)

the vagina. Great care must be exercised in doing this, as perforation of the bladder with the finger is easily brought about. It is best separated by means of a gauze swab, aided by snips with the scissors where adhesions are firmer, and particularly where bladder muscle tissue is seen left attached to the front of the cervix. Should an opening be made into the bladder it should be closed at once with catgut sutures. If the wall has not been much damaged or bruised it will probably unite, the organ being drained subsequently with a self retaining catheter. There is risk, however, of subsequent leakage, possibly from sloughing with the formation of a urinary fistula that may be difficult to close. If the growth is so adherent to the bladder that it cannot be removed without resecting a

portion of the wall, the question of continuing or not the operation will have to be carefully considered. Unfortunately in most cases the adhesion involves the region of the trigone and ureters, and under these circumstances the operation is better discontinued. The discomfort of the patient after wide removal of bladder wall which cannot be closed, and perhaps injury to ureters, is so great that the further attempt to remove the growth is inadvisable. Apart from infiltration of its wall most difficulty will be found in the separation of the bladder close to the insertion of the ureters,

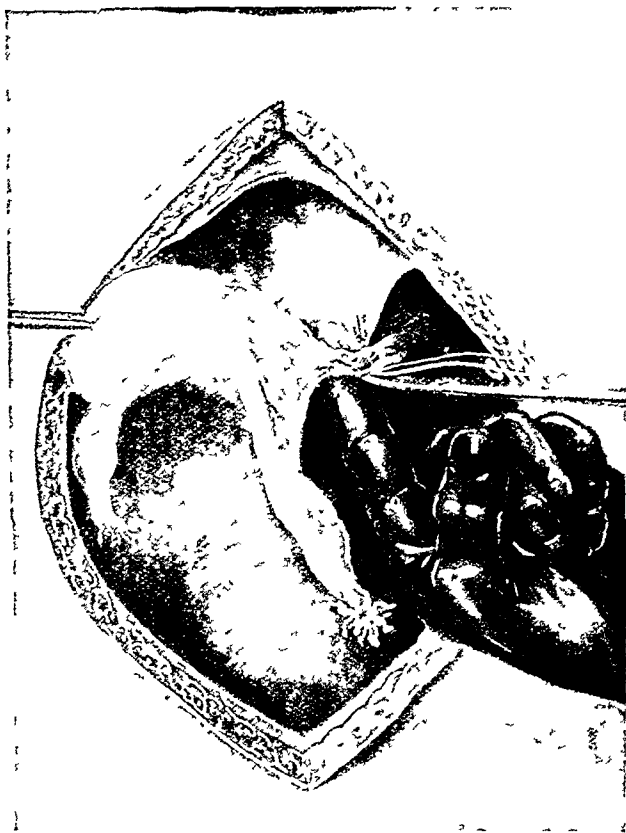


FIG 471. Wertheim's operation. Ligature being passed round the uterine vessels (after Wertheim)

and much care must be taken here not to injure them. Should a ureter be injured at this or in later stages, the best procedure is not definitely established. It is usually recommended to insert the cut end into the bladder. This I believe to be followed often by leakage, by occlusion of the ureter or ascending pyelo-nephritis. I believe the best plan is to tie the cut end, dealing later with the kidney should trouble in that organ supervene. In the one case in which I cut through a ureter and tied it, the patient had very little pain in the corresponding kidney and no subsequent trouble (*see pp. 588 to 591*).

(4) **Ligature of the Uterine Vessels.** Having divided the broad ligaments on each side, we shall see the ureters passing forward to the base

of the bladder and crossed at the level of the cervix by the uterine vessels surrounded by a certain amount of cellular tissue. The simplest way of securing these is to pass an index finger along the ureter towards the base of the bladder and beneath the vessels which are in this way safely raised from the ureters and ligatured as near to the pelvic wall as is possible. Before securing the uterine vessels the course of the ureter towards the bladder should be carefully defined to make certain that it is not included in the ligature.

(5) **Separation of Ureters** As soon as the uterine vessels have been

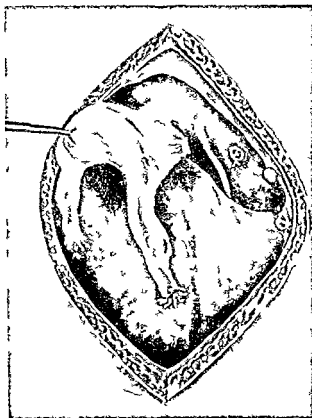


FIG. 4. Wertheim's operation. Uterine vessels divided and right ureter exposed as far as its entrance into bladder (after Wertheim).

divided the ureters become accessible. They are now exposed as far forwards as their entry into the bladder. A few careful snips with the scissors on their inner aspect will allow them to be drawn well aside from the cervix. They should not be detached in their entire circumference if this can be avoided.

(6) **Separation of Rectum** The uterus is drawn well forwards and the peritoneum at the back of the vagina is seized in a pair of forceps and divided with scissors. Through the opening thus made the finger is introduced and separates the rectum from the upper part of the vagina. The utero-sacral folds on each side are then seized in clamp forceps and divided on the uterine side of the forceps.

(7) **Division of Parametrium and Vagina.** The ureter being pulled well to the side of the pelvis, the parametrium is seized in strong clamp forceps, two or three being applied to each side, and the cellular tissues divided between the uterus and forceps. The uterus and upper part of the vagina are now entirely freed, and all that remains for the removal of the uterus is to divide the vagina well below the growth. This is generally effected by clamping the vagina with strong right-angled forceps and cutting across below the forceps. Much stress has been laid on the use of

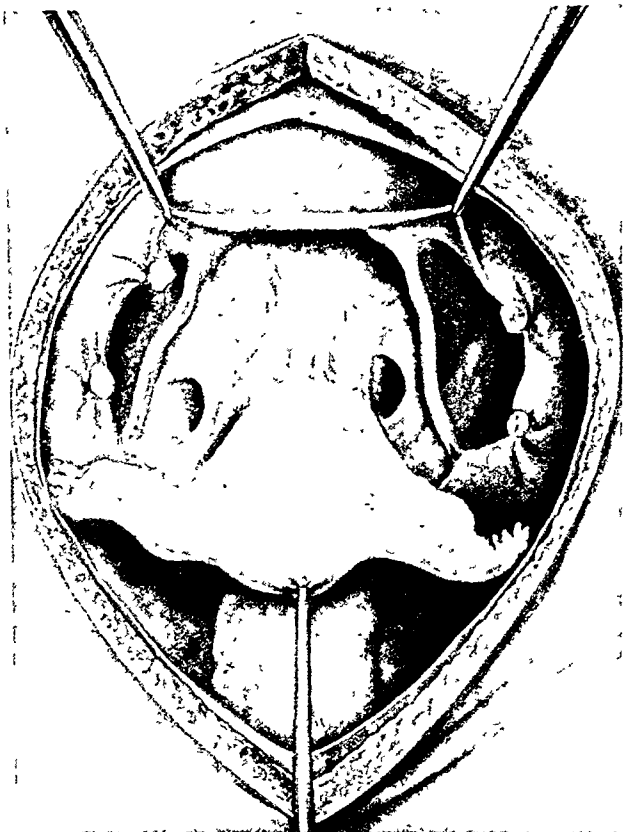


FIG. 473. Wertheim's operation. Both ureters shown exposed as far forward as their entrance into bladder (after Wertheim).

the forceps applied in this way, as minimising the risk of reinfection from growth, and of sepsis. Much trouble from bleeding will be avoided by applying forceps to the two lateral angles of the vagina below the clamps before separation of the uterus is carried out.

(8) **Removal of Glands, Suturing of Peritoneum, &c.** The subsequent stages of this operation, although they may be described shortly, may prove to be tedious. Ligatures are applied in the place of the forceps on the parametrium and utero-sacral folds. All other bleeding-points having been secured, the peritoneum where divided is sewn up with continuous catgut sutures.

Complications. The more important risks of the operation are injuries

to the bladder and ureters, and hæmorrhage. The former have already been mentioned and the mode of dealing with them described. Bleeding may add very greatly to the difficulties of the operation. The parts are often vascular, constant oozing taking place from numerous points in the wound. It is most likely to be troublesome when the plexus of veins round the vaginal vault is injured, as may occur in the separation of the bladder and ureter, or later on from the slipping of forceps applied to the parametrium. It may be sufficient to obscure dangerously the further

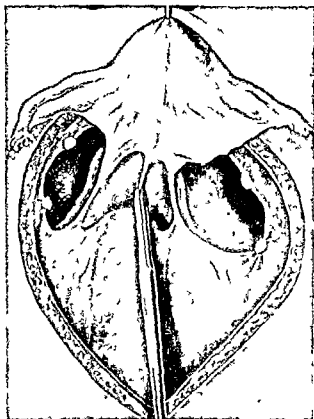


FIG. 474. Wertheim's operation. The peritoneum of Douglas's pouch picked up by forceps preparatory to being divided (after Wertheim).

stages of the operation and may even necessitate firm packing and the discontinuance of the operation. The most frequent complication after the operation is cystitis. Septic troubles are found chiefly in suppuration of the abdominal wound or in pelvic abscesses.

Carcinoma of the body is dealt with in the same way by the abdominal route. The operation is more easily performed as a rule owing to the cervix being free from growth. In old or debilitated patients on whom as described above, this operation cannot be performed the uterus can be more quickly removed by operating as for panhysterectomy of fibroids.

CÆSARIAN SECTION

Indications. Owing to the marked improvement that has taken place in the maternal prognosis of late years in the hands of skilled operators and under favourable conditions, the scope of this operation has been much widened. In cases of pelvic contraction it is no longer confined to those cases in which a foetus cannot be extracted through the natural passages, but includes all cases in which, at full time, it is reasonable to

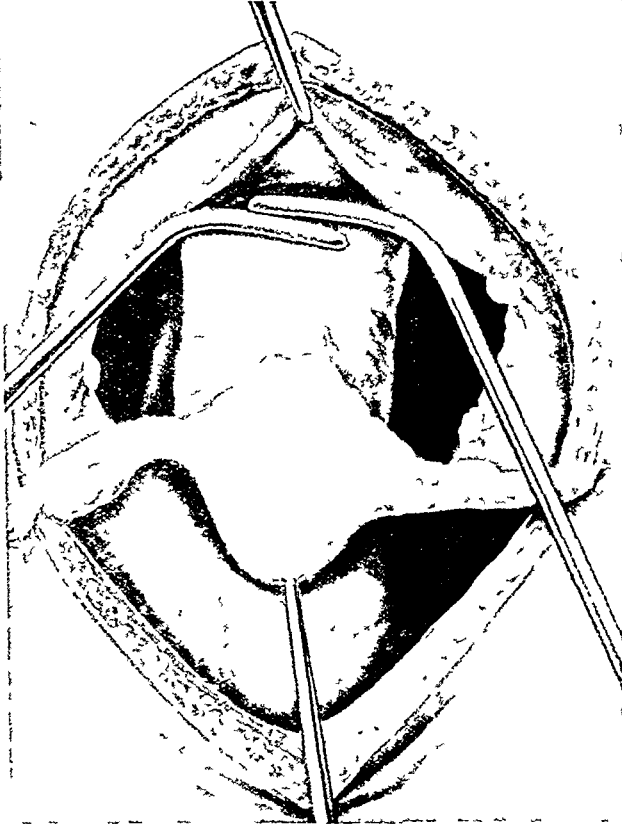


FIG. 475 Wertheim's operation. The uterus freed from its connections all round. Clamp forceps applied to the vagina (after Wertheim)

suppose that a living child will not be born, that is as an alternative to craniotomy. In skilled hands, it is undoubtedly preferable to prolonged high forceps extractions, so liable from the stretching and tearing of pelvic structures to lead to prolapse. In cases of contraction recognised beforehand, it may be considered as an alternative to induction of labour.

Rarer indications for operation due to obstruction are found in the case of tumours of the pelvis or pelvic organs, or atresia of the vagina from cicatrisation.

It has also been widely employed in such conditions as eclampsia, concealed accidental hæmorrhage, and certain cases of central placenta prævia.

Time of Operating. There are three possibilities: (1) To wait until

labour comes on spontaneously (2) To operate at a certain fixed time before the commencement of labour pains (3) To induce labour by the passage of a bougie and operate at a pre-arranged time

The great objection to waiting for the onset of natural labour is that the operation may have to be performed at night often without the necessary assistance and with the patient imperfectly prepared For these reasons many surgeons prefer to operate at a definite time which is arranged for a few days before full term This is undoubtedly the most satisfactory plan The operation can be undertaken in daylight the needful assistance is forthcoming and the patient can undergo the proper preliminary treatment—as necessary in Cæsarian section as for any other abdominal operation The chief objection made to operating before the onset of labour is that the uterus may not contract well with the risk of hæmorrhage that imperfect contraction entails Practical experience has however shown that the fear of uterine inertia and bleeding is unfounded As regards the induction of labour it is now recognised that all manipulations carried out beforehand by the vaginal route lead to increased risk in the operation from sepsis Moreover the onset of labour as determined by bougies is too uncertain to be of much value

Operation There should be two assistants in addition to the anæsthetist one to stand opposite the surgeon and assist in the various manipulations the other to hand instruments whilst some one in addition should be present who is competent to attend to the child when delivered

Abdominal Incision The incision through the abdominal wall should be eight inches long of which about a third will be above the umbilicus whilst the lower end should not be nearer than two or three inches to the pubes The incision is made deliberately in the median line as already described in the operation for ovariotomy The peritoneum being reached is picked up and opened and then divided on the fingers for the full length of the skin incision In dividing this structure downwards towards the pubes the fingers used as directors will serve to detect the bladder if this is much drawn up—a complication most likely to be found when labour has been protracted The next step is the opening of the uterus and this and the following stages in the operation should be performed as rapidly as possible

Incision of Uterus The uterus should be opened as it lies in the abdomen, care being taken that it is mesial in position A small incision is made with a scalpel through the whole thickness of the wall As the membranes are reached these are opened and the liquor amni gushes out Two fingers used as a director are inserted into the uterine cavity and the wound rapidly enlarged up and down Care should be taken in carrying the wound downwards that the bladder is not opened Hæmorrhage is likely to be very free when the placenta is in front It is sometimes recommended that the incision should be carried through the placenta There is no need to do this The hand passed into the uterus and separating the placenta from the uterine wall quickly reaches the membranes When the placenta has been cut through or injured it has been recommended to pull out a loop of cord and compress it to prevent loss of foetal blood As the child can be extracted with equal rapidity there can be no object in this procedure

Extraction of Child The uterus having been opened the surgeon

introduces a hand and seizes a knee or foot and delivers the child. It has been recommended, on account of occasional trouble in the extraction of the after-coming head, that this should be delivered first. It is not, however, easy to grasp, and will probably require both hands, which take up more room than is convenient in the uterine wound. Difficulty in extraction of the head is generally due to too small an incision in the uterine wall. The child having been delivered, the funis is clamped and divided. After the removal of the child, the uterus, being sufficiently diminished in size, is brought out through the abdominal wound, and a large flat sponge or gauze roll placed behind it. The placenta and membranes are then carefully peeled off the uterine wall and removed. If the uterus does not contract readily, it should be stimulated to do so by compression, and by covering the organ with a large swab wrung out of hot saline solution.

Uterine Sutures. Both silk and catgut sutures are employed for this purpose. Though catgut has been largely used one or two cases have been recorded where ligatures of this material have given way, an accident I have seen happen. On the other hand, silk ligatures may become infected and lead to sinuses. On the whole, stout catgut that will not become absorbed too soon appears to be the best material. About ten deep sutures should be inserted half an inch or rather more apart. They are introduced half an inch from the edge of the wound on a half-curved or fully-curved needle, and are brought out on the cut surface close to the decidual surface of the uterus. There can be no real objection to passing them through the whole thickness of the wall, bringing them out on the decidual surface close to the cut edge, and in actual practice this is no doubt often done. These are tied tightly, and if bleeding is free it is a good plan to secure some of the ligatures before they are all introduced. A continuous Lembert suture, picking up not only peritoneum but a small portion of muscle, has proved to be a satisfactory method of completing the closing of the wound.

Sterilisation of Patient. To within the last few years the usual practice was to sterilise patients when the condition requiring Cæsarian section was one which could not be remedied. At the present time many surgeons are opposed to this practice. On ethical grounds it has been held that the responsibility for future pregnancies does not rest with the doctor, and in Dr. Herbert Spencer's words "that it was his duty to deliver the woman and restore her as nearly as possible to a natural condition, a result obtained by the conservative operation without sterilisation."¹ One strong point against sterilisation is that the child may die, and that the mother's chances of further pregnancy have been destroyed. On the other hand, we have the repeated risk of the operation, which however at the present day is a small one. There is further the danger of rupture of the uterus, and that this is a real one is shown by the number of cases reported of this accident. I prefer not to sterilise at the first operation, but to do so on the second occasion if the first child is alive and well and the second one holds out promise of living. If sterilisation is decided upon it is performed as follows: The tube being picked up, a double ligature, threaded on a pedicle needle, is passed through the broad ligament a sufficient distance below it. The loop having been divided, the two strands

¹ *Obstet. Trans.*, 1904, xlv., 334.

are interlocked and one is tied round the tube close to its uterine end, whilst the other is tied round the free edge of the broad ligament beyond the fimbriated extremity. The ovary should not be included in the ligature which should be carried between it and the Fallopian tube. The tube is then cut away between the two ligatures.

Cæsarian Section followed by Hysterectomy There are certain conditions in which removal of the uterus is called for after the extraction of the child. Some of the indications are as follows:

(1) Failure of the uterus to contract after removal of the child. This occurs most often in cases of concealed accidental hæmorrhage.

(2) Injuries to the uterus sustained in efforts to deliver through the pelvis such as rupture.

(3) When there is some reason to think that the uterus has been infected, experience shows clearly that the risk of the operation for Cæsarian section lies in those cases in which much manipulation by the vaginal route has been carried out beforehand.

Removal of the uterus may be indicated in the radical treatment of the condition giving rise to the obstruction. This gives such further indications as follows:

(4) When the uterus contains fibro myomata.

(5) When there is cancer of the cervix. If this condition is found to exist and hysterectomy is decided on, the whole uterus must be removed. In all cases except those in which carcinoma of the cervix exists, partial hysterectomy should be performed. The steps of the operation are similar to those already described for the removal of a fibro myomatous uterus.

ECTOPIC GESTATION

From the point of view of treatment cases of extra uterine gestation are best considered under three headings: (1) *Before rupture has taken place*, (2) *at the time of rupture*, (3) *after rupture*.

(1) **Cases in which the Tube is Unruptured.** As rupture of the tube almost invariably occurs before the tenth week, this class may be held to include cases of extra uterine gestation up to two and a half months. If there is any suspicion that a tubal pregnancy exists, the patient should submit to operation at once. Delay means the risk of rupture and severe or fatal hæmorrhage. The operation is practically identical with that described for removal of the appendages. Adhesions are recent and do not give rise to much trouble. Care must be taken not to rupture the sac in the separation of adhesions or in drawing it up into the wound for the purpose of ligaturing the broad ligament. Should severe hæmorrhage from this cause occur, it should be controlled by quickly applying the ligatures to the pedicle or by controlling the blood supply at the uterine cornu and the brim of the pelvis.

(2) **At the time of Rupture.** The condition most often calling for operative measures is the result of rupture of the tube, or abortion. Rupture may take place either into the peritoneal cavity or between the layers of the broad ligament. It more often happens, however, that hæmorrhage from the tube is associated with the formation of a mole which the tube attempts to expel, though generally without success from

is then brought up into the wound and ligatures applied, as described in the section on the removal of the appendages

(3) **After Rupture of Sac** Under this heading may be included those cases which are seen some time after rupture or abortion has occurred. Treatment then resolves itself into dealing with a collection of blood in the pelvis, either shut off by adhesions and matted viscera from the general peritoneal cavity, or lying between the layers of the broad ligament

If on account of recurrent attacks of pain and marked *anæmia* there is reason to suspect repeated hæmorrhages abdominal section should be performed and the tube removed. This will differ from the operation undertaken at the time of rupture in that the tube and blood-clot will be found enclosed by adhesions and matted bowel and omentum. These latter must be carefully separated until the sac and surrounding blood clot are brought into view. The tube is then dealt with as previously described. If some time has elapsed since the accident and the hæmatocele, more especially if it is a *small one* shows signs of undergoing absorption, the case may be treated by rest, in the hope that the swelling will subside

Should the hæmatocele be a large one it is better to deal with it by opening the abdomen than by the older method of drainage through the vagina. This is liable to be attended by hæmorrhage which has at times proved fatal or to be followed by infection of the pelvic cavity. Vaginal drainage should be confined to those cases in which infection of the hæmatocele has clearly taken place

If the fœtus survives the patient runs the risk of a secondary rupture, and, as pregnancy advances, operation is attended with increasing danger. During the first four months of gestation there is no doubt about the advisability of immediate operation and the removal of sac, fœtus and placenta may be attempted. After this time there is considerable difference of opinion as to the best time to operate, though the tendency at the present day is to advise operation as soon as a diagnosis is made. There seems no doubt that operations undertaken after the death of the fœtus at full term are attended by less danger of hæmorrhage owing to the shrinkage of the placental vessels. Though the risk of death from hæmorrhage is thereby greatly diminished this delay is attended by the possibility of putrefactive changes taking place in the ovum. The only two cases I have seen were successfully dealt with by this plan of waiting till the fœtus was dead and the blood supply had dried up, in both cases the operation being performed about a month after term. As the child is often malformed, any measures undertaken should be in the interest of the mother rather than of the child

An incision should be made in the median line, and low down to begin with between the symphysis and umbilicus to avoid the possibility of injury to a placenta seated in the upper part of the sac. The difficulties of removal of the sac are so great and so fraught with danger, that the safest plan of dealing with it is to suture its edges to the abdominal incision. Where possible the peritoneal cavity should not be opened. The greatest difficulty that the surgeon has to contend with is the placenta. If some weeks have elapsed since full term it can be removed as a rule without difficulty. It can also be removed in some cases before or at full term in which it is situated in the upper part of the sac. If the placenta

cannot be removed with the sac but is attached low down, the best plan is to tie the cord close to the placenta without disturbing the latter, and to pack the cavity with iodoform gauze. This should be renewed daily. At the end of a fortnight to three weeks an attempt is made to remove the placenta, the packing of the sac being continued till it is obliterated. The great risk of this procedure is septic infection before the placenta can be removed. Another plan is to close the abdominal wound leaving the placenta *in situ*, trusting to atrophy and absorption of the latter taking place. Owing to the close proximity of the bowel, infection is a not unlikely contingent, and the wound may have to be re-opened on account of suppuration.

CHAPTER XXXII

LIGATURE OF VESSELS

SURGICAL TREATMENT OF ABDOMINAL ANEURYSM

LIGATURE OF THE EXTERNAL ILIAC (Figs 476 and 477)

Indications Chiefly 1 *Some cases of aneurysm of the upper part of the femoral or of the femoral encroaching on the external iliac itself* Mr Holmes¹ showed that in ilio femoral aneurysms it is often very difficult to say whether the aneurysm is or is not limited to the iliac or femoral *ie* whether it is wholly above or below the place where the deep epigastric and circumflex iliac come off or whether the mouths of these vessels open out of the sac In the former case the aneurysm would be purely iliac or femoral, in the latter ilio femoral

In ruptured femoral aneurysm excision (facilitated by the application of a tourniquet above) would usually be indicated but Mr Southam² briefly reported a case in which he tied the external iliac successfully in a patient whose femoral aneurysm suddenly ruptured and became diffuse The effused blood was quickly absorbed and there was never any tendency to gangrene Complete power over the limb was regained

2 *Wounds* A wound of the external iliac is very rare³ The artery has been frequently tied for hæmorrhage from parts below *eg* for reactionary and secondary hæmorrhage after wounds of the femoral high up, after ligature of the femoral and after amputation at or near the hip The futility of this treatment was shown by Otis

Dr Otis⁴ gives a summary of twenty six cases in which the external iliac was tied for such cases as the above Of these twenty three ended fatally, a mortality of 88·4 per cent The uselessness of trusting to ligature of the external iliac in such cases, instead of either securing the wounded vessel itself or trusting to well applied pressure, was long before this insisted on by Guthrie⁵

It is far better to open the wound so that the actual source of bleeding can be found and the vessels tied below, as well as above the bleeding spot Mr Pringle⁶ has successfully sutured a wound of the external iliac The opening was a quarter of an inch long and was sewn up with catgut which produced a kink in the artery, but no leakage took place, and six months later the man was quite well and able to work The

¹ R.C.S. Lect., *Lancet* 1873 i, 296

² *Brit Med Journ* 1883 i, 818

³ The only case with which I am acquainted is one quoted by Mr Enchsen from Velpéau (*Nouv Elém de Méd Opér* t. i, p. 175), in which the above French surgeon was suddenly called upon to tie the external iliac for a knife-wound Though there had been no preliminary dilatation of the collateral circulation either by pressure or by the presence of an aneurysm the result was successful.

⁴ *Med and Surg History of the War of the Rebellion* pt. ii, p. 788

⁵ *Wounds and Injuries of the Arteries* Lects. v and vi

⁶ *Scottish Med and Surg Journ*, October, 1901

deep circumflex iliac artery was tied, because it originated a quarter of an inch below the incision in the artery. During the operation bleeding was prevented by pressure on the abdominal aorta. This brilliant result adds another reason for opening the wound and seeking the bleeding spot in all cases of hæmorrhage from a wound near large vessels.

3. *Elephantiasis*. Ligature of the external iliac or femoral (when the condition of the soft parts admit of it) has been extolled by some surgeons in the treatment of this affection. A larger experience shows, however, that when cases thus treated are watched, the cures cannot be relied upon as permanent. Moreover, too little value has been attached, in reported cures by ligature of the main vessel, to the thorough rest and elevated position entailed by tying the artery.

Handley's operation of lymphangioplasty is far more hopeful, but this operation cannot be safely undertaken when cracks, foul ulcers or bacterial infection make asepsis impossible. Martin's bandages are sufficient for mild cases.

4. *As a distal operation in aneurysm of the common iliac*. Ligature of the external iliac has been so unsuccessful here as to call for no further comment.

Surgical Anatomy.

Extent. From the lumbo-sacral articulation to a point just internal to the centre of Poupart's ligament. *Length*. Three and a half to four inches.

Surface Marking. From a point an inch below and to the left of the umbilicus to a point just internal to the centre of Poupart's ligament.

In Front.

Relations :

Peritoneum, small intestines.

Iliac fascia.

Lymphatic glands and vessels.

Genito-crural nerve (genital branch).

Spermatic vessels

Circumflex iliac vein

} Crossing artery near Poupart's
ligament.

Outer Side.

Psoas (above).

Iliac fascia.

External iliac
artery.

Inner Side.

Iliac fascia.
Vein.

Behind.

Iliac Fascia.

Vein (above).

Psoas (below).

Vas deferens (dipping
from internal ring
to pelvis).

Collateral Circulation.

Deep epigastric	with	Internal mammary, lower intercostals and lumbar.
Deep circumflex iliac	„	Ilio-lumbar, lumbar and gluteal.
Gluteal and sciatic	„	Internal and external circum-

Comes nervi ischiadici	with	Perforating branches of profunda
Obturator		Circumflex arteries and epi gastric
Internal pudic		External pudic

Operation (1) By the lower and more transverse incision of Sir A Cooper (2) By the muscle slitting extra peritoneal method (3) By the higher and more vertical incision of Abernethy These are compared at p 859 (4) By the intra peritoneal method (p 863)

(1) *Incision of Sir A Cooper* This is the method more frequently

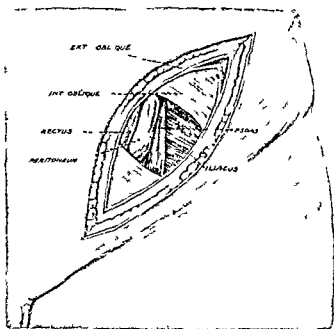


FIG 476 The gridiron incision for exposing the iliac vessels The peritoneum is drawn in The rectus sheath is always opened to give more room

made use of An incision is made five inches long parallel with Poupart's ligament and nearly an inch above it commencing just outside the centre of the ligament and extending outwards and upwards beyond the anterior superior spine¹ The superficial fascia and fat varying in amount, being divided and the superficial circumflex iliac vessels secured, the external oblique both fleshy and aponeurotic, is cut through, and then the fleshy fibres of the internal oblique and transversalis This is done either by using the knife alone, lightly and carefully, or by taking up each layer with

¹ The incision may have to be made higher than usual owing to the upward extension of the aneurysm, to enable the surgeon to tie either the upper part of the external or the common iliac On this point see the remarks on the comparison of Cooper's and Abernethy's operations p 849 Often in these cases of upward extension of the aneurysm the sac is found to involve the lower part of the artery and to have overlapped the upper portion

forceps, nicking it, and slitting it up on a director. If the wound be sponged carefully, a layer of cellular tissue can usually be seen between the muscles, however thin they are. Any muscular branches should be tied at once. The fascia transversalis, when exposed, will be found to vary a good deal in thickness and in the amount of fat which it contains. It is to

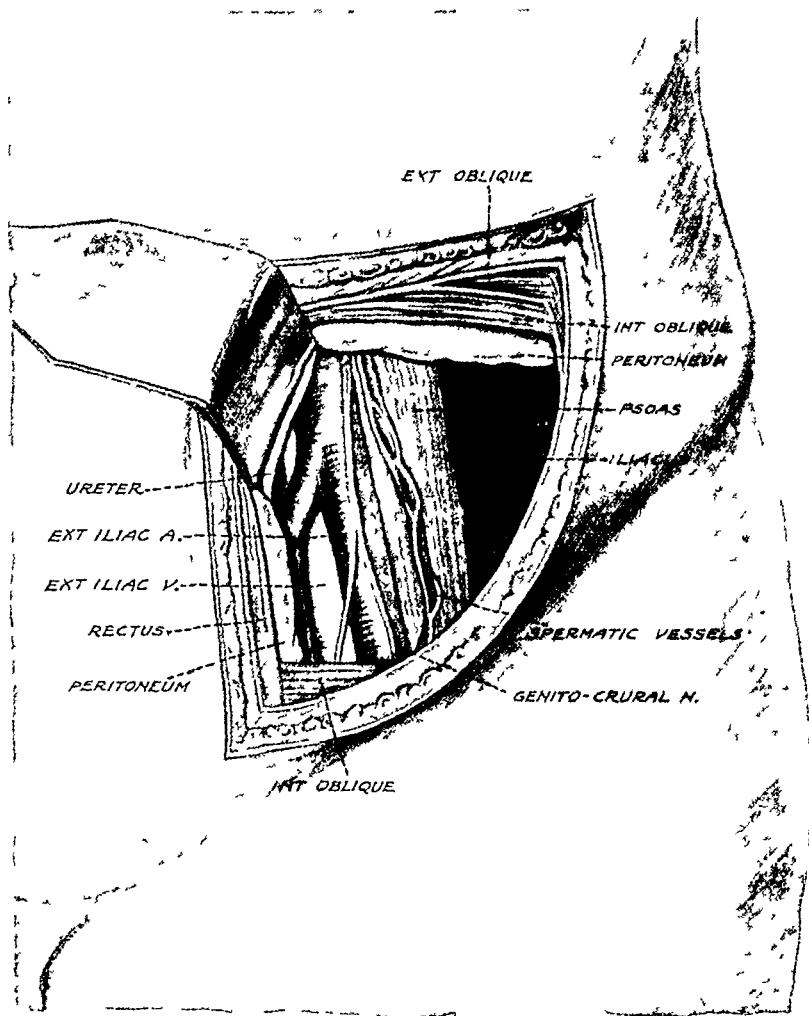


FIG 477 The relations of the iliac vessels are well shown. The gridiron incision prolonged into the rectus sheath has been used.

be divided very carefully, and the extra-peritoneal fat, if present, will next come into view. First one and then two fingers being introduced, the peritoneum is to be gently stripped up from the iliac fossa towards the middle line, *i.e.* upwards and inwards as far as the inner border of the psoas. In doing this care must be taken, especially in the dead body, not to separate the iliac fascia and the vessels from their position on the psoas, not to tear this muscle and not to lacerate the peritoneum. As soon

as the peritoneum has been well raised, an assistant keeps this and the upper lip of the wound well out of the way by means of broad retractors. The surgeon then feels for the pulsation of the artery on the inner border of the psoas, and carefully opens the layer of fascia which ties the vessel to the psoas, and forms a weak sheath to it. This should be done one and a quarter inches above Poupart's ligament so as to lie well above the origin of the deep epigastric, which usually comes off a quarter or half an inch above Poupart's ligament, and the needle passed from within outwards, carefully avoiding the vein on the inner side and the genito-crural nerve outside and in front. In difficult cases the ligature (of No 3 chromic gut) must mainly be passed by touch but a free incision, adequate use of retractors and light thrown in by a head lamp will usually allow the surgeon to see what he is doing. The effect of tightening the ligature being satisfactory, it is cut short and dropped in, the divided muscles are then brought together with buried catgut sutures, and the superficial wound closed. The parts must be kept relaxed by propping the chest up slightly and flexing the knees over a soft pillow. The limb is evenly bandaged from the toes upwards raised and kept covered in cotton wool, with hot bottles placed in the bed. In case of threatening gangrene assistants should persevere in a trial of friction of the limb from below upwards.

(2) *Muscle Slitting Incision* After slitting the external oblique as described under Cooper's operation, the fibres of the internal oblique and transversalis muscles are separated, as in McBurney's operation for appendicitis. The wound is enlarged by cutting into the rectus sheath and drawing the muscle inwards. By adopting this method the risk of ventral hernia is greatly diminished, and the difficulties of the operation are not materially increased, if good retractors are used (see Figs 476 and 477).

(3) *Incision of Abernethy* In his first operation this surgeon made his incision in the line of the artery for about three inches commencing nearly four inches above Poupart's ligament. Later on he modified his incision by making it less vertical and more curved, with its convexity downwards and outwards, and extending between the following points, viz one about one inch internal and one inch above the anterior superior spine to one inch and a half above and external to the centre of Poupart's ligament.

The respective advantages and disadvantages of the methods of Cooper and Abernethy appear to be the following. Cooper's is rather the easier, interfering, as it does, with the peritoneum less and lower down. It is most suitable to those cases which do not extend far, if at all, above Poupart's ligament. On the other hand where the extent to which the aneurysm reaches upwards is not exactly known, Abernethy's operation, hitting off the artery, as it does, higher up, or some modification of that given (p 863) for ligature of the common iliac will be found preferable.

Difficulties and Possible Mistakes. (1) Too short an incision. (2) A wrongly placed incision, i.e. one which, by going too near the middle line, opens the internal abdominal ring, or which, if too low, may come too near the cord. (3) Disturbing the planes of cellular tissue needlessly or roughly. (4) Wounding the peritoneum, owing to a hasty incision.

through a thin abdominal wall, by rough use of a director, especially if the peritoneum is adherent in the neighbourhood of the sac or fused with the transversalis fascia. The peritoneum is often difficult to distinguish; it is bluish in aspect, but of course not smooth, being covered with cellular tissue which connects it to the extra-peritoneal fat. (5) Stripping up the peritoneum roughly and too far. (6) Detaching the artery from the psoas. (7) Lacerating the psoas. (8) Tying or injuring the vein. (9) Including the genito-crural nerve. (10) An abnormal position of the artery. This may be due to an exaggeration of that naturally tortuous condition of the artery which is especially likely to be met with in patients advanced in life. Another unusual cause of displacement may be met with in extravasated blood when an aneurysm has given away.

Sir W. Fergusson briefly reported ¹ an instance of this kind, in which the sac gave way after repeated manipulation.

Causes of Failure and Death. 1. *Gangrene.* In some cases, where the limb does not become gangrenous, the vitality is very feeble and requires much attention.

Thus, in Mr. Rivington's case,² loss of sensation was noticed on the fourth day followed by paralysis of most of the muscles. Though gangrene did not appear and the patient survived five and a half months, the limb was "on the verge of gangrene," as shown by sores appearing on the heel and great toe.³

2. *Secondary hæmorrhage.* This was not uncommon when wounds became septic, especially if silk was used. It is mentioned here as a warning of the need of perfect asepsis.

Thus, in Mr. Rivington's case,⁴ the patient died of secondary hæmorrhage five and a half months after the operation; the wound had been found septic at the first dressing; a catgut ligature was used.

Early recurrence of pulsation may be ominous of secondary hæmorrhage.

In a case of Sir A. Cooper's, the hæmorrhage which proved fatal a fortnight after the operation was found to be due to a large collateral, viz. an abnormal obturator arising immediately above the site of ligature.⁵

3. *Phlebitis* from injury to the external iliac vein.

4. *Recurrence of pulsation.* This is especially likely to occur when a catgut ligature has been used and given away, owing to its being too quickly absorbed.

5. *Formation of a ventral hernia.* This should be prevented as far as possible by ensuring primary union, and by separating the muscle fibres instead of cutting across them. Later on, if this complication threaten, an appropriate truss should be worn.

LIGATURE OF THE COMMON ILIAC (Figs. 476 and 477)

Indications. Very few. For gangrene of the foot frequently follows the operation. Temporary ligature may induce clotting in an aneurysm without risk of gangrene.

¹ *Brit. Med. Journ.*, 1873, i, 286.

² *Clin. Soc. Trans.*, xix, 45.

³ In one of Dr. Sheen's cases (*Brit. Med. Journ.*, 1882, ii, 720) four days after the operation a large patch of skin on the outer side of the thigh was noticed to be darkish in colour, and to pit on pressure, though normal as to sensation. The case did quite well.

⁴ *Loc. supra cit.*

⁵ Roux, *Parallèle de la Chir. anglaise avec la Chir. française*, &c., pp. 278, 279.

1. *Aneurysms.* Especially those inguinal aneurysms which affect the external iliac in its upper part, above the origin of the deep epigastric, occupying the iliac fossa and lower part of the abdomen. When such aneurysms are progressing steadily, when they have resisted a trial of pressure or are becoming diffuse, ligature of the common iliac is indicated.

2. *Wounds.* These may be gunshot or bayonet wounds, or knife stabs of the vessel itself or the internal iliac or its branches, usually the latter. Bleeding from these branches is best treated by opening the wound, identifying the vessel and securing it on each side of the bleeding spot, failing thus the internal iliac should be tied. The hæmorrhage calling for ligature seems to be usually secondary.¹

Dr S. Smith² gives two cases of ligature of the common iliac for wounds. One of these is of great interest, as the common and internal iliac were here tied for severe hæmorrhage after a stab in the inguinal region. A large quantity of blood was found in the peritoneal cavity, and the patient died ten hours after the operation. At the necropsy it was found that the deep epigastric was the wounded vessel.

3. *For the arrest of hæmorrhage* after amputation near the hip from the branches of the internal iliac in what is usually the posterior flap.

4. *For pulsating tumours simulating aneurysm.* As these growths from the iliac fossa and the walls of the pelvis have been found to be malignant, it is of the utmost importance to form a correct diagnosis in these cases, and thus save a patient who has a certainly fatal disorder from being submitted to an operation which is dangerous, and almost certain to be useless.³ As mistakes have, however, been made in these cases by excellent surgeons,⁴ the chief points of diagnosis, as given by Mr Holmes,⁵ may be briefly mentioned here. (a) The bruit is usually less well marked, (b) the pulsation is less heaving and less expansile, (c) the condition of the bone with which the swelling is connected, thus a plate of bone may be found in the supposed aneurysmal sac, the supposed aneurysm may be found both on the gluteal and the iliac aspects of the pelvis, the bone being expanded by the growth. (d) Cancerous cachexia may be present, and perhaps secondary growths as well. To these may be added the valuable evidence which may be given by the X rays.

5. *For hæmorrhage, not the result of a wound.* Mr Morrant Baker,⁶ has put on record a case of great interest in diagnosis, in which an abscess from sacro iliac disease ulcerated into branches of the internal iliac artery, and when opened gave rise to hæmorrhage calling for ligature of the common iliac.

¹ It would naturally be thought that hæmorrhage from a wound of the common iliac would be fatal before a ligature could be applied. Dr Otis gives a case in which this vessel was wounded by a ball entering from the buttock through the sacro-iliac synchondrosis. Death took place from hæmorrhage on the second day.

² *Amer Journ Med Sci*, 1860, xi, 1.

³ In Guthrie's case, a pulsating tumour in the right buttock, the size of an adult head, diminished by one half in a month. Two months later it again enlarged, and the patient dying eight months after the operation, an immense encysted tumour was found occupying the right iliac region.

⁴ *E.g.* Guthrie (*Lond Med Gaz*, n, 1834), Stanley (*Med Chir Trans*, xxviii), Moore, (*ibid*, xxxv).

⁵ *Syst of Surg*, iii, 44, 145. The reader should also consult Mr Holmes's article, "On Pulsating Tumours which are not Aneurysmal, and on Aneurysms which are not Pulsating Tumours" (*St George's Hospital Reports* vii).

⁶ *St Bartholomew's Hospital Reports*, 1872, viii, 120.

A gardener, aged 17, had felt pain a month previously while digging. A tense, elastic swelling, distinctly fluctuating and acutely tender, occupied all the right buttock. It was opened, and a small stream of apparently arterial blood escaped without jets. On further exploration the finger entered a large cavity between the iliac bone and the glutei. The iliac fossa was full and tense, and on examination per rectum a swelling was found in the right ischio-rectal fossa. On enlarging the gluteal wound a steady stream of arterial blood welled up through the great sacro-sciatic foramen. This was firmly plugged, and the common iliac tied. On removing the plug some bleeding still occurred, but was easily arrested. The gluteal wound became offensive, and this region, together with the upper part of the thigh, became gangrenous, the leg and foot remaining unaffected. The patient died forty hours after the operation.

At the necropsy the sacro-iliac joint was open, with surrounding caries. The remains of a large abscess were found, involving the branches of the internal iliac. There was no trace of aneurysm.

Surgical Anatomy. The common iliacs, coming off on the left side of the fourth lumbar vertebra, incline downwards and outwards to divide, opposite to the lumbo-sacral intervertebral disc, into the internal and external iliacs. The right is rather the longer and more oblique of the two. Their length is usually an inch and a half. Their branches are few and small, viz. to the ureter, psoas muscles, glands, &c. The iliacs become increasingly tortuous with age: a point of importance in tying the vessel on an aged person.

Line. One drawn from a point an inch and a half below and a little to the left of the umbilicus to the centre of Poupart's ligament, the line curving a little outwards, will represent the course of the artery with sufficient accuracy.

Guide. The above line is the only surface guide; more deeply the lumbo-sacral articulation and the psoas muscles are useful guides, especially in a thin subject.¹

Relations :

In Front.

Peritoneum; small intestine; cæcum and appendix, sometimes.
Ureter.
Sympathetic.

Outside

**Right common
iliac artery.**

Inside

Psoas.

Vena cava.

Right common
iliac vein.

Left common iliac vein.

Behind

Right and left common iliac veins.

In Front.

Peritoneum; small intestine.
Sympathetic.
Ureter.
Superior hæmorrhoidal artery.

¹ Attention has been drawn to the need of employing touch, as well as sight, in the ligature of these large trunks (p. 859).

Outside

Psoas

Left common
iliac artery*Behind*

Left common iliac vein

Collateral Circulation The chief vessels are

*Above*Internal mammary and
lower intercostals

Lumbar

Middle sacral

Superior hæmorrhoidal

with

Deep epigastric

Ilio lumbar and circumflex
iliac

Lateral sacral

Inferior and middle hæmorrhoidal

Below

Operations (Fig 477) The common iliac may be exposed either extra or transperitoneally. Of these the extraperitoneal route is the best. A posterior abdominal or loin incision by which the vessel is reached from behind a method made use of by Sir P Crampton of Dublin in 1828 and by Mr Stanley at St Bartholomew's in 1846 does not afford such direct access. Moreover it damages the muscles and nerves of the abdominal wall too much. The same objections apply to anterior incision of Mott. The peritoneum is separated from the flank and iliac fossa and displaced well in by broad retractors. The Trendelenburg position improves the view. The psoas muscle is felt and seen. On the inner side of this muscle the artery will be found the external iliac being traced up if needful. To aid the surgeon in the difficulties which are now met with owing to the artery lying at the bottom of a very deep wound the abdominal walls should be relaxed by bending up the thighs the wound sponged thoroughly dry and light thrown in by a reflector or head lamp. The position of the vessel having been made out it is defined with a blunt director special care being taken on the right side as here both the common iliac veins lie behind the artery. The needle should be passed from within outwards the ureter being drawn inwards and avoided.

LIGATURE OF THE INTERNAL ILIAC (Fig 477)

Indications Very few and rare

(i) In some cases of gluteal and sciatic aneurysms. Mr Holmes in the course of those lectures from which I have already quoted lays down conclusions which will very greatly help the surgeon in deciding what form of treatment is best suited to these aneurysms. They are quoted under the heading of Ligature of the Gluteal Artery (vol 1 p 839).

(ii) Hæmorrhage. This is most frequently met with in military surgery after gunshot wounds of the vessel itself but more often of one or more of its branches within the pelvis the bullet entering usually from the front through the inguinal region or behind through the sacrum.

(iii) To bring about atrophy of the enlarged senile prostate.

Dr. Bier was the first to tie the internal iliacs for the above purpose.¹

The two cases in which Dr. Bier operated by the extraperitoneal method recovered. Neither, before the operation, had been able to pass a drop of urine. Spontaneous power returned in each case and improved progressively, one of the patients stating, four months later, that he could micturate as well as ever before.

Enucleation of the prostate is easier and more certain.

(iv) In some cases of vascular pelvic sarcoma and inoperable uterine tumours.²

Surgical Anatomy. A short trunk, about an inch and a half long, of large size, the internal iliac, given off opposite to the lumbo-sacral intervertebral disc, dips downwards and backwards as far as the upper part of the sacro-sciatic notch, where it gives off its anterior and posterior trunks, a ligamentous cord also coming off from the bifurcation. This cord, the remains of the obliterated hypogastric artery, usually remains pervious as far as the bladder, as one of the vesical arteries.

Line. No distinct line or guide can be given for this vessel owing to its at once dipping into the pelvis, but it will be worth while to remember that a line drawn with a slight curve outwards from a point about an inch below and a little to the left of the umbilicus, to the centre of Poupart's ligament, gives sufficiently accurately the line of the common and external iliac arteries; the internal is given off about two inches from the commencement of this line.³

Relations :

	<i>In Front</i>	
	Ureter.	
	Peritoneum.	
	Rectum (left side).	
<i>Outside.</i>		<i>Inside</i>
Right internal iliac vein.	Internal iliac artery.	Pyriformis.
Obturator nerve.		Sacral nerves.
	<i>Behind</i>	
	Internal iliac vein.	
	Sacro-iliac synchondrosis.	
	Lumbo-sacral cord.	

Collateral Circulation :

Sciatic	with	Superior branches of profunda.
Hæmorrhoidal branches	„	Inferior mesenteric.
Pubic branch of obturator	„	Vessel of opposite side.
Branches of pubic	„	Branches of opposite vessel
Circumflex and perforating of profunda	„	Sciatic and gluteal.
Lateral sacral	„	Middle sacral.
Circumflex iliac	„	Ilio-lumbar and gluteal.

¹ *Wien. Klin. Woch.*, No. 32, August 10, 1893.

² Baudet and Kendirdjy, *Gaz. des Hôpitaux*, April 1, 1899.

³ The origin of the arteries will be found nearly opposite to the centre of a line drawn from the anterior superior spine to the umbilicus.

Operation. An incision five inches long is made vertically over the outer and lower third of the rectus, and this muscle is displaced outwards. The posterior wall of the rectus sheath and the thin transversalis fascia are very carefully divided. The peritoneum having been displaced inwards and upwards the hips are well flexed and the lips of the wound retracted as widely as possible. The finger now finds the external iliac, and then by tracing it up, the internal iliac vessel.¹ The cord like obturator nerve must not be mistaken for this. The Trendelenburg position is adopted and improves the view.

The artery is now separated partly with the finger and partly with the point of the director and the needle passed from within outwards avoiding the vein and psoas muscle. The ureter usually crosses the artery at its commencement, and must be drawn out of harm's way. It will be well to have in readiness aneurysm needles of different curves and an ordinary silver probe.

Ligature of the Internal and other Iliacs by Abdominal Section. This method has been advocated by Dr Dennis² of New York for the following reasons. (1) Abdominal section in no way increases the dangers of the operation of ligature of the internal iliac. (2) This method prevents a series of accidents which have occurred during the performance of the operation of ligature of this artery by the older methods. Amongst these are the division of the circumflex and epigastric arteries wounding the vas deferens including the ureter in the ligature puncturing the iliac or circumflex veins tying the genital branch of the genito crural and tearing the peritoneum. (3) Abdominal section enables the surgeon to apply the ligature at a point of election and to obtain information as to the exact extent of the main arterial trunk. (4) Securing the internal iliac by this method takes much less time than was occupied by the older ones. The free extraperitoneal incision advised above avoids most dangers.

A few cases in which the iliac arteries have been tied intraperitoneally are on record. One of the most interesting of these is fully recorded by Sir George Makins.³

The patient, aged 30 had an inguinal aneurysm about two inches in breadth extending upwards about two-fifths of the distance between the middle of Poupart's ligament and the umbilicus, and for about two inches below the ligament. An incision four inches long was made in the left linea semilunaris the deep epigastric which originated in the swelling was tied between two ligatures. The small intestines were held over to the right with Messrs. Ballance and Edmunds' broad abdominal retractor, the sigmoid flexure was pushed upwards and an incision made through the lower part of its mesentery and the peritoneum at the margin of the pelvis in the course of the external iliac. The wound was deep there being about an inch and a half of subcutaneous fat and abundance of fat in the subperitoneal tissue both beneath the anterior abdominal wall and around the vessel. This together with some retching rendered the freeing of the artery and the passage of the ligature a process of some difficulty. The spermatic vessels were also exposed and swelled up considerably in the wound. The artery was secured about three quarters of an inch below the bifurcation of the common iliac and an inch and a half above the sac. Two threads of stout flossy sterilised silk were tied separately but in close apposition, and with sufficient firmness to rupture the internal and middle coats. The posterior peritoneum was sutured over the artery. The patient left

¹ The finger should be passed downwards and backwards towards the sacro iliac synchondrosis.

² *New York Med News* November 90 1866 *Annals of Surgery* 1887 v 55

³ *Lancet* 1892 ii 1378

the hospital, with the aneurysm hard, painless and shrinking, on the forty-seventh day.

The following remarks of Makins, well known not only as a surgeon but also as an anatomist. I quote *verbatim* :

“The reason for selection of the intraperitoneal method in this case was the high position of the aneurysm. Before operation the pulsation in the iliac fossa was so forcible and extensive that it seemed probable that it might prove necessary to ligature the common iliac, and it was thought that this would be more readily performed by the intraperitoneal method. Beyond this the intraperitoneal method seemed to offer the great advantage of not in the least interfering with the coverings of the sac, which, by the ordinary method, might have been disturbed by the stripping of the peritoneum. The experience gained by the operation showed that the usual method might have been safely adopted, but this could not be definitely determined beforehand. An advantage was gained in ready access to the deep epigastric artery, which, as directly feeding the sac itself, needed ligature, but, of course, might readily have been secured by an extension of the ordinary wound. As to the comparative difficulty of the two operations I think there is little to choose, and on the whole the incision for the extraperitoneal method is perhaps to be preferred in the matter of cicatrix ; in the vertical incision the advantage of suturing the fibrous structures in the linea semilunaris is gained ; but, on the other hand, the resulting cicatrix passes directly through from skin to peritoneum. In the oblique incision the decussation of the various muscular layers leads to a certain intricacy and irregularity in the line of the cicatrix which may render it the stronger since pressure is less readily brought to bear directly upon it. The choice of the iliac vessels obtained is, I think, a real advantage, since the incision needs neither extension nor modification ; but in saying this it should be pointed out that this is a much stronger argument on the right than on the left side of the body. Ligature of the right common iliac artery by the intraperitoneal method is probably the easiest of all the operations on the great arteries, since the vessel lies directly beneath the peritoneum of the posterior abdominal wall, uncovered by any structure of importance. On the left side, on the other hand, the inferior mesenteric vessels as they enter the sigmoid mesocolon, and pass down to the mesorectum, cover practically the whole of the artery, and to reach the common iliac comfortably and safely the peritoneum would need to be divided close to the left of the median line of the sacrum and displaced outwards. This manœuvre has the disadvantage of exposing the vein freely, but this would probably give far less trouble than the numerous mesenteric vessels would when swollen by reason of the loss of their peritoneal support. In the case recorded above the distension of the spermatic vessels, when set free by the division of the peritoneum, was much greater than would have been expected.”

This most instructive case possesses the additional and especial interest that the patient developed a similar aneurysm on the right side a few months later.¹

On May 3, 1893, Makins tied the right external iliac intraperitoneally. An incision, commencing an inch below the level of the umbilicus and four inches long was made in the right linea semilunaris. The abdomen being opened, the small intestine was packed away with two small sponges, and the posterior wall exposed. The artery was then seen below the termination of the ileum, crossed by the spermatic vessels. The aneurysmal sac was about an inch and a half in diameter. The peritoneum over the artery being divided, the vessel was ligatured with two strands of floss silk, tied with separate reef-knots, and then the peritoneum sutured over the artery. The patient was kept in bed for two weeks, and went out on the thirty-eighth day, having made an excellent recovery. A firm linear scar was present in the left linea semilunaris, and two small, hard swellings marked the site of the cured aneurysms. Makins stated that he repeated the transperitoneal method here because the first had proved so successful, and because the aneurysm, though small, was situated entirely above Poupart's ligament. The operation on the right

¹ *Lancet*, 1893, ii, 196.

side proved much easier than that on the left since the crossing of the ileum was on a higher level than was the case with the sigmoid mesocolon. The artery also was far more prominent on the brim of the pelvis. The circulation was re-established much more rapidly and satisfactorily after the second than after the first operation. On the first occasion the limb was very cold and the patient suffered much neuralgic pain; on the second the local temperature fell little if at all and the patient had no pain. On the first occasion the deep epigastric was tied a step not taken on the second but Makins was inclined to think that the rapid re-establishment of the circulation was rather dependent on the enlargement of the branches of the interval iliac on the opposite side resulting from the obstruction of the first external iliac artery.

Sir Wm Mitchell Banks¹ Mr Wherry² and Sir Frederick Treves³ recorded similar cases.

The following was Sir Frederick Treves' opinion of the merits of the operation⁴ and he was inclined to extend this method to the common iliac also. The advantages of this method are obvious. The vessel is easily and fully exposed and the needle can be passed without risk to the vein or ureter. The operation is simple and involves but little time. Its dangers are comparatively speaking very few. The ligature can be applied accurately at the spot determined upon. The condition of the artery and the surrounding parts can be made out and a diagnosis confirmed or modified. The great objection that some few years ago would have been urged against the procedure—the risk of acute peritonitis—may be at the present day almost disregarded.

Writing as I do for those whose operative experience is not to be compared with that of the late Sir Frederick Treves I hesitate to endorse the above opinion in its entirety. I am of opinion that with the above incision the intestines will sometimes give great trouble. Mr Maynard⁵ in tying the right common iliac artery for a diffusing aneurysm of the external iliac had much trouble with the small intestines the whole of which had to be drawn out of the abdomen and wrapped in warm sterilised towels. The operation then became perfectly simple. Mr Maynard did not have the advantages of the Trendelenburg position and of broad and deep retractors both of which are invaluable. The patient died on the seventh day the cause of death remaining uncertain for no autopsy was allowed. Mr Currie⁶ records a successful case of transperitoneal ligation of the left external iliac for aneurysm of its lower part. A median incision was used and the artery was easily tied with the aid of the Trendelenburg position and good retractors. A good deal of handling and exposure will be inevitable and we all know that where the above are entailed under unfavourable circumstances as in warfare septic peritonitis may develop. Under favourable circumstances with modern skill in abdominal surgery and the advantage of the Trendelenburg position good intestinal retractors and reflected light it is certain that the transperitoneal approach will become more and more popular for the reasons so clearly indicated by Sir Frederick Treves and Sir George Makins (p. 866). This route is particularly suitable

¹ *Brit Med Journ* 1890 ii, 1163

² *Lancet* 1893 ii, 136

³ *Operative Surgery* i, 213

⁴ *Loc supra cit* p. 211

⁵ *Ind Med Gazette*, July 1903 xxxviii, No. 7

⁶ *Ann of Surg* 1905 xli, 690

for ligation of the internal and common iliac, and for cases of aneurysm of the external iliac when it is not certain beforehand that a ligature can be safely applied to this vessel extraperitoneally. In these a peritoneal incision enables the surgeon to decide whether a ligature can be placed on the external iliac or must be applied to the common iliac—a much more risky procedure as regards gangrene of the foot and leg. In gunshot injuries or stabs the intraperitoneal method will, of course, be made use of so that the abdomen can be explored.

LIGATURE OF THE ABDOMINAL AORTA

Indications. As this most rare operation has been fatal in nearly every case its justifiability has naturally been called in question. On the one hand, the desperate condition of the patients, the advanced amount of disease probably present in their arteries, hearts, &c., the large and rapid blood-current, the disturbance of very vital parts and the risk of overstraining the heart and of paralysis, all combine to render the probability of success extremely small. On the other hand, recent improvements in surgery, the introduction of better ligatures, the fact that in these cases life must speedily end if nothing be done and, perhaps, the fact that many of the major operations of surgery have been unsuccessful at first, will justify surgeons in again making trial of this forlorn hope, if they feel certain that otherwise the case is quite hopeless. Since R. T. Morris¹ has been able to demonstrate the possibility of making an aortic aneurysm “fill with clots by the application of a temporary ligature to the aorta, and that circulation in the extremities can be re-established on the removal of the ligature,” some hope may be entertained of obtaining a success by a modification of his method.

(1) *Aneurysm.* The cases have mostly been those of aortic, iliac and inguinal aneurysm in which other arteries have been tied without success. To justify the epithet above given of “desperate,” the first case, the well-known one of Sir A. Cooper (in 1817),² may be alluded to.

Here the patient had long suffered from an aneurysm affecting the external and common iliac arteries, leading to sloughing of the skin and hæmorrhage. Sir Astley having failed in an attempt to perform the old operation, owing to the artery lying so deeply, gave the patient “the only hope of safety” which remained by tying the aorta.

As life was here prolonged for forty hours, and as in Monteiro’s case death did not take place till the tenth day, proof is given of the restoration of the collateral circulation.³ M. R. Reid,⁴ in an important communication recording all the cases of aneurysm ever treated in the surgical service of the Johns Hopkins’ Hospital up to January, 1922, states that there were

¹ *Ann. of Surg.*, 1902, xxxv, 207.

² *Prin. and Pract. of Surg.* (edited by Dr. Lee), i, 228.

³ In comparing instances of the restoration of the circulation, the one by disease and the other after the surgeon’s ligature, the importance of the slow and gradual process in the one case will not be lost sight of. Mr. Barwell (*Intern. Encycl. of Surg.*, iii, 481) alludes to the experiments of Pirogoff (Waller and von Gräfe’s *Journ.*, Bd. xxvii, S. 122) and a paper by Kast (*Zeit. f. Chir.*, Bd. xii, S. 405) to show that the collateral circulation is established. Sir A. Cooper (*loc. supra cit.*) used to show in his lectures an injected specimen from a dog which survived the operation. Beyond this fact, however, no comparison can be made between the chance of survival of healthy animals and that of patients reduced to such straits as to call for this operation.

⁴ *Arch. of Surg.*, 1926, xii, 1-69.

seven ligations of the aorta for five patients. Metallic bands and broad tapes were used. Three ligatures were above the diaphragm, one complete and two partial. The abdominal aorta was completely occluded once and partly occluded three times. All five patients died, the longest survival being for 134 days. In three instances the ligature (two tapes and a band) cut through the vessel wall once with fatal bleeding.

Rudolph Matas² reports a very interesting and successful ligation of the aorta for an aneurysm at its bifurcation and makes the following instructive remarks.

The fact that the circulation in the lower extremities had been well maintained during the period of total occlusion (nine days) shows that the collateral circulation had developed sufficiently before the ligation to insure the vitality of the lower limbs, although not enough to prevent an undue and almost fatal strain upon the heart. The great improvement in all subjective symptoms and in the objective signs of the aneurysm (progressive reduction in the size of the aneurysm, increasing hardness, contraction of the pulsating area, diminution in the extent and intensity of the aneurysmal bruits) which were most noticeable towards the end of the patient's life, as the blood pressure fell with the advancing tubercular infection, strongly suggest that a complete consolidation and cure of the aneurysm was about to be effected, when the patient's life was cut short by the overwhelming tubercular infection and fulminating pulmonary hæmorrhage—one year, five months and nine days after the ligation.

The clinical evidence to this effect was fully confirmed at the post mortem findings which showed that the sac had filled with firm laminated clot and that the aortic blood stream reached the lower extremities only through an open channel in the sac that led to the left common iliac—the right common iliac having been obliterated in the walls of the sac.

In conclusion this observation shows that even though a primary total (atretic) occlusion of the abdominal aorta through the relaxation of the ligature material gradually becomes a *partial* (stenotic) occlusion, the much reduced circulation in the sac which follows this relaxation is not necessarily prohibitive of cure, but may in reality prove of advantage in favouring a more gradual but firmer consolidation of the clot. Further more, the gradual yielding of the ligature material in weak exhausted patients with feeble hearts, ill prepared to stand the enormous strain of a total aortic occlusion, as was notably the case with this patient, may save a heart that would otherwise have succumbed more any yielding material had been used for the ligation. Again the facts revealed by the anatomical and histological study of the aorta at the seat of the ligature conclusively prove that tape ligatures made of cotton fabric when applied with sufficient force completely to occlude the lumen of the aorta remain encysted in the walls of the artery and are perfectly tolerated by the tissues. In this case the tapes remained imbedded in the aortic walls as a constricting ring for over seventeen months without causing the slightest necrotic or degenerative changes in the intima. In fact the vessel walls were strengthened by the dense capsule of organised exudates and fibrous tissue of new formation in which the tapes were imbedded. In view of the perfect tolerance of this material by the blood vessel wall it would seem superfluous to resort to strips of fascia or of aorta or other less readily available

² *Ann. of Surg.* 19-5 lxxxi 457

or dependable (shorter lived) material, for the purpose of occluding a large artery of the calibre of the aorta. On the other hand, ligatures made of more rigid or unyielding material (metallic bands) which will maintain a complete atresic occlusion of the aortic lumen are more likely to cause premature ulceration, atropic, or necrotic changes in the arterial wall, which may end in disastrous hæmorrhages. For this reason the writer still holds to cotton or silk tape as the safest or most practical material for the ligation of the aorta and its great primary branches (innominate, left carotid, left subclavian, common iliacs, at their origin), as first taught by the late Professor Halsted in the latter part of his career."

(2) *Hæmorrhage*. In addition to the above cases in which the aorta has been tied in cases of aneurysm, it has been tied once for hæmorrhage by Czerny, of Heidelberg.

After a gunshot injury of the upper part of the thigh, hæmorrhage continuing, the common femoral was tied, together with the superficial femoral below the profunda. Bleeding taking place again in six days, the common iliac was tied. The hæmorrhage still persisting, it was thought that the external iliac only had been tied, and a ligature was next placed, by mistake, upon the aorta. The patient lived twenty-six hours. The same surgeon during a nephrectomy for a soft malignant growth of the kidney met with such uncontrollable hæmorrhage as to compel him to tie the aorta, the patient dying soon after.

Surgical Anatomy. The lowest part of the aorta, viz. that between the bifurcation and the origin of the inferior mesenteric, is that which should be chosen.¹

The vessel may have in front of it the omentum, duodenum, mesentery, small intestines and, more closely, the aortic plexus of the sympathetic and a layer of fascia of various strength. To the right side lies the vena cava, and behind it are the left lumbar veins. The bifurcation is usually situated a little to the left side of the umbilicus and about three-quarters of an inch below it.

Operation. This may be performed (A) through or (B) behind the peritoneum. The intraperitoneal method is especially indicated when the height at which the ligature must be applied, or any evidence of matting of the structures of the abdominal wall (dating to inflammation about the aneurysm, or to the use of pressure) would probably interfere with stripping up the peritoneum.

A. Through the Peritoneum. The high Trendelenburg position is adopted, and an incision five inches long, with its centre opposite the navel, is made displacing outwards the left rectus. The intestines are packed up out of the way and the peritoneum over the lower part of the aorta is picked up and incised. Care should be taken to disturb as little as possible the aortic plexus² during this step and in passing the needle, which should be carried from right to left.

The passage of the needle may be attended with much difficulty, not only from the depth of the vessel, and from the presence of intestines if distended and allowed to protrude into the wound, but also from the

¹ This interval varies in length from half an inch to two inches.

² Sir A. Cooper (*loc. supra cit.*) believed that his experiments on dogs proved that inclusion of this plexus, and not the interruption of the circulation, was the cause of the paralysis which followed the experiment. In Mr. James's case, when the ligature was tightened, the patient complained of "deadness in the lower extremities." This was soon followed by agonising pain in the same parts, only relieved by death about three hours after the operation.

density of the cellular tissues surrounding the artery. Matas¹ recommends using two completely occluding woven cotton tapes each ligature half an inch wide in juxtaposition one above the other. To prevent slipping of the knots they are transixed with silk sutures.

B Behind the Peritoneum The chief objection to this method is the great depth at which the artery is reached but it is well worthy of notice that in Monteiro's case which survived ten days this method was made use of.

The operation is performed on much the same lines as that already given for ligature of the common iliac (p. 863). The incision should be free. The muscles and transversalis fascia being cut through the peritoneum is stripped up and turned inwards several large retractors placed in the wound and the ribs dragged up and outwards. The common iliac being found this vessel is traced up into the aorta.

THE SURGICAL TREATMENT OF ABDOMINAL ANEURYSM

(A) Aneurysm of the Abdominal Aorta The prognosis of this disease remains extremely grave. The late Dr J. H. Bryant² found that the average duration of life in these cases is about thirteen months from the time that the aneurysm first becomes manifest³. He pointed out that the condition was correctly diagnosed during life in only eighteen of his fifty-four cases and also that the opposite mistake of diagnosing an abdominal aneurysm which is not present is even more frequent—67 per cent. of the cases occur in the neighbourhood of the celiac axis.

A few cases of spontaneous recovery are on record and Osler⁴ has seen at least two instances of spontaneous healing in aneurysm of the abdominal aorta. Very little is to be hoped for from medical treatment. Osler has never seen a case cured by medical treatment. The Tufnell diet and large doses of iodide of potassium are disappointing and unpleasant; the gelatine treatment is dangerous and of but little permanent value.

Surgical procedures may prolong life in some cases and shorten it in others; cures have resulted in exceptional instances.

(1) Compression above the sac in the rare cases that it is possible to apply it may be successful as in the case under Dr Murray of Newcastle this patient remained well for six years. This treatment can rarely be employed owing to the high position of the great majority of aortic aneurysms (*vide supra*) and it is not free of danger the intestines and other viscera being liable to serious injury from compression against the spine. The latter objections apply equally to distal compression.

(2) Acupuncture A brilliantly successful case of abdominal aneurysm treated by Prof. MacEwen with needles and the formation of white thrombi may be mentioned. This patient was at work for over two years and a half after the treatment.

(3) Introduction of Wire (Moore) Prof. Loreta of Bologna applied

¹ *Loc. supra cit.*

² *Clinic Journ.* November 25, 1903.

³ G. H. Colt from an investigation of forty-one consecutive fatal cases not treated surgically gives the mean clinical duration as 13.5 months and the longest time noted as forty-two months (*Brit. Journ. Surg.* 1925 xi, 113).

⁴ *Lancet* 1905 ii, 1039.

this method to one case of abdominal aneurysm which attracted much attention at the time, but proved, as is so common in these cases, only temporarily successful. An account will be found,¹ taken from the original paper.²

Sir D'Arcy Power and Mr. G. H. Colt³ reported a case in which 80

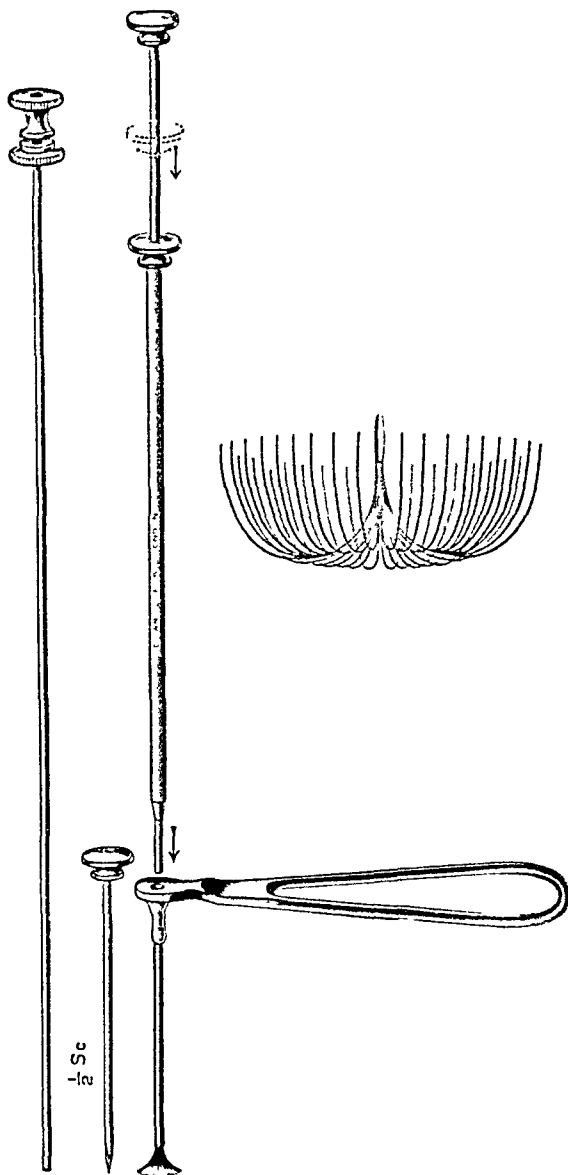


FIG. 478. Mr. G. H. Colt's apparatus for wiring aneurysms (Down Bros.).

inches of silver wire were introduced into an abdominal aneurysm through an ingenious and valuable instrument invented by Mr. Colt. Since then the instrument and technic have been so greatly improved that this

¹ *Brit. Med. Journ.*, 1885, i, 745, 955.

² *Mem. Roy. Acad. Scien. Institute of Bologna*, February 8, 1885.

³ *Lancet*, 1903, ii, 808.

method is by far the best and safest one for wiring aneurysms. It is certainly worthy of further trial.

I venture to quote Sir D'Arcy Power's¹ lucid account of the technic: "Pathological aneurysms the result of chronic inflammation of the large arteries in the chest and abdomen are of so deadly a nature and run so distressing a course that any means of relieving the symptoms even temporarily, must be welcomed by every one who is brought in contact with the unfortunate sufferers, and the means is doubly welcome if it offers even a remote chance of a cure. I make no excuse, therefore in directing attention to a method of relieving the pain which is so constant a feature of the disease.

"The apparatus employed was invented by my former house surgeon, Mr G. H. Colt. Its object is to enable a known quantity of wire to be introduced into the sac of an aneurysm with the least disturbance of parts, the maximum of speed and the certainty of asepsis. Entrance of wire into the aorta which is known to have occurred in at least seven cases is also prevented. The instrument (Fig. 478) consists of a trocar and cannula, a ramrod, a tube and a wisp. The wisp consists of a number of fine steel wires soldered together at one end, each wire being curled over in a separate plane so that it readily expands as soon as it is set free from any controlling force, though under ordinary conditions the wires are picked together and the individual strands lie parallel to each other. The wisp in fact is like a miniature umbrella which has a constant tendency to remain open, the end where the wires are soldered together is the handle of the umbrella and the individual wires are the ribs. Originally a double wisp or 'cage' with the wires soldered together in the middle (as illustrated) was intended to be used for a large sac, but it was found that the second half of the cage did not expand with certainty after its insertion, so that its use has been discontinued. Each wisp fits into a hollow metal tube—open at both ends—so fashioned that it can be fitted easily and accurately to the distal end of the cannula after the trocar has been withdrawn. It then forms an extension of the cannula. This tube holds the wisp in its compressed condition as a bundle of wires lying side by side. The wisps are made of different sizes for use with different sized aneurysms. The amount of wire in each is known and is always the same for the same size. Thus No. 1 wisp has a total surface area of $1\frac{1}{4}$ square inches and is composed of 75 inches of wire, wisp No. 2—the one generally used—has a surface of $2\frac{1}{2}$ square inches and the total amount of wire is 105 inches, and wisp No. 3 has $3\frac{1}{2}$ square inches and consists of 150 inches of wire. The wires composing the wisps are dull gilt and if they be examined under the microscope or passed through the fingers the gilding will be found to have made them slightly granular. This irregularity of surface is intentional, and enables the blood clot to form more quickly and to adhere more firmly than if the wires were smooth.

"Every part of the apparatus can be sterilised by being boiled, and the method of using it is very simple. Care must first be taken to ascertain that the wisp expands freely as soon as it leaves the tube. The skin over the most pulsatile portion of aneurysm is divided and the trocar and cannula are thrust into the sac. The trocar is then withdrawn and a jet of blood issues with considerable force if the cavity of the aneurysm has been reached. The tube containing the wisp is then fitted to the projecting end

¹ Brit. Journ. Surg., 1921, ix, 27.

of the cannula and the wisp is pushed into the aneurysm by means of the ramrod. If this be done steadily and gently the wisp is entirely released and falls into the cavity of the aneurysm, the expanding wires first and the soldered end last. The cannula is then withdrawn, and the skin incision is closed with a single point suture if necessary. Hitherto each operation has been performed under a general anaesthetic, but I believe local anaesthesia would be quite sufficient in most cases. I began by making a considerable incision in order to expose the sac, but now I merely puncture the skin to prevent the point of the trocar carrying epithelial cells in front of it into the aneurysm.

"Experience has taught me one or two points of importance in performing the operation. In the first place it is necessary to have a free jet of blood issuing from the cannula when the trocar is withdrawn: it is then certain that the whole thickness of the wall of the aneurysm has been pierced, and the wisp will be delivered into the fluid blood, for it will be useless if it merely lies in the active or pre-existing laminated clot.

"The introduction of the wisp by means of the ramrod should be done deliberately, and the cannula withdrawn afterwards steadily and without jerking, or the wisp may jump out of the puncture, as happened in one of my cases (*vide* p. 29)¹ when I attempted to operate too quickly. Even in a large thoracic aneurysm the wall of the sac is sufficiently elastic to prevent any escape of blood when the cannula has been withdrawn. This fact had to be learnt by experience. I feared at first that the puncture would continue to bleed and I used to suture the wall at the seat of puncture and reinforce it in the neighbourhood with a few additional sutures until I saw this precaution was unnecessary, for there was no bleeding when the cannula was drawn out. I have, therefore, abandoned suturing in my later cases. The operation is attended with so little pain or after-disturbance that narcotics are often not needed: indeed it is better not to give them, because the patient has usually suffered so much that he craves for them, and the operation is a good opportunity to break him of the habit. Where the pain is severe full doses of aspirin are usually sufficient, especially if the patient can be assured that within a few hours, or at most a day or two, the pain will disappear. . . . I do not see any advantage in combining electrolysis with wiring. It prolongs the operation, it introduces additional factors of danger, and it does not alter the physiological effect of the treatment, which is to obtain clotting within the sac. Admittedly the chief effect of it is to *initiate* the process of clotting, and this we now know is done quickly by the granular surface of the dull-gilt wisp. I have therefore never employed electrolysis, for it has always seemed to me to be reminiscent of a time when little was known of the physiological processes connected with the clotting of the blood and too much was expected of electrical treatment. . . . I have purposely headed this paper, 'The Palliative Treatment of Aneurysm by Wiring,' because I do not wish to raise vain hopes about the treatment of a deadly disease. I know quite well that relief from pain is often secured by rest in bed for a prolonged period of time on a low diet with restriction of fluids and the administration of large doses of iodide of potassium. In the cases which have been given in this article these methods had been tried by competent persons under the best possible conditions of nursing,

¹ *Brit. Jour. Surg.*, 1921, ix, 29.

and had failed. In nearly all the cases the pain was relieved by wiring and two of the patients returned voluntarily and asked for a second operation. In some of the cases recorded an actual cure of the aneurysm seems to have followed the introduction of the wire but in spite of the figures which Mr Colt has been good enough to supply we do not yet know enough about the natural history of the disease to say whether this great prolongation of life was in consequence of the operation or whether it would have occurred spontaneously. This will form the subject of a future investigation.

Mr G. H. Colt has added five more cases to those recorded by Sir D. Arcy Power making twenty one in all. Mr Colt makes the following remarks upon the results:

'In the absence of any authoritative statement of the clinical duration of aneurysm it is difficult to assess the value of any particular method of treatment. While America holds the world's record for thoracic aneurysm treated by wiring and electrolysis Dublin holds the record for abdominal aneurysm treated by wiring alone. The medical profession in Dublin in the past have added so greatly to our knowledge of the disease that it is most fitting that Sir William Wheeler's first case a male (T) aged thirty eight with a positive Wassermann at the time of the operation on August 30th 1910 should be alive and working in a brewery to day fourteen years and six months later. His second case a male of thirty lived in good health and died four years and eight months after operation from leakage of a secondary dilatation the sac post mortem was solid (King Fretz). Lawson's patient lived ten and a half years no details could be ascertained of the pathological state. Up to the present time in the remaining eleven cases of abdominal aneurysm one patient lived a year one some months one six weeks and the other eight died within nine days of the operation at least three of them from acute dilatation of the stomach. Some of the others may have died of this but the accounts are not complete. The three cases were Wheeler's third case Marshall's and my own and it is clear that the condition arises either as a result of the change occurring in a consolidating sac or as a result of some nervous or vascular change induced by the trauma.

As already mentioned the average duration of life in these cases of abdominal aneurysm without surgical treatment is only thirteen months but as Colt points out

Sir William Wheeler's two successful cases and Lawson's case are entirely beyond these figures and so were the cases recorded by Langton (eleven years ten months) and Morse (four years) wired by the older method. It is now clearly proved that the dull gilt wisp is sufficient to initiate active clotting in a saccular aneurysm even in an actively syphilitic patient and that it is unlikely to project through the opening of the sac. The wires do not become dissolved or broken and appear to cause no trouble after many years. It would appear that the employment of electrolysis is not essential to start the clotting and the experiments of Dawson Turner² amply confirm this.

M. R. Reid³ reports forty cases of wired aneurysms at the Johns Hopkins Hospital.

¹ *Brit Journ Surg* 1913 xii 111

² *Proc Roy Soc Med (Elect Sect)* 1909 i 124

³ *Arch of Surg* 1906 xii 74

"Eight of these were of the abdominal aorta ; twelve of the ascending arch of the aorta ; ten of the transverse arch of the aorta ; eight of the descending arch of the aorta ; one of the innominate artery ; and one of the superior mesenteric artery. No patient was cured. Possibly five patients were relieved by the operation. Many results checked as improved on the front sheets of the histories were not substantiated by a more careful study of the cases." It is significant that the technic and instruments of Colt were not available for these cases, so that considerable lengths, instead of mere wisps, of wire had to be used and sometimes strayed into the main artery and, not uncommonly, damaged the wall of the aneurysm, occasionally hastening rupture. Further, electrolysis was used in addition without apparent benefit.

(4) **Ligature of the Abdominal Aorta.** This has been already discussed (p. 868).

(5) **Temporary Ligature of the Aorta.** Prof. Keen,¹ who publishes a case of ligature of the abdominal aorta just below the diaphragm, the patient surviving forty-eight days, has devised an instrument by means of which temporary compression of the aorta may be carried out. The instrument, which is fully described and figured, consists of a screw clamp in two parts, which is applied directly to the aorta through an opening in the abdominal wall.

Four experiments on dogs are described, the results of which clearly show the feasibility of the plan.

Prof. Keen considers that the instrument might be used either for a short interval under anæsthesia, or might be left *in situ* for two or three days, during which pressure could be applied at intervals.

R. T. Morris² records a most interesting and suggestive case of temporary distal ligation of the abdominal aorta by means of a rubber catheter passed round the artery and kept taut by means of long clamp forceps. The elastic ligature was removed. after twenty-seven hours, the aneurysm having filled with clot. Soon afterwards pulsation and sensation returned in the lower extremities. The patient, however, died on the third day from septicæmia, probably the result of gangrene of portions of the intestine which had been compressed by the steel clamp, but the patient also suffered from a previous pyonephrosis.

At the autopsy the aneurysm was found to be filled with clot. but the aortic lumen was patent. At the site of the elastic ligature the internal coat was not divided.

This case proves "that an aneurysm of the aorta can be made to fill with clots by the application of a temporary ligature to the aorta, and that the circulation in the extremities may re-establish on the removal of the ligature."

R. T. Stratton³ records five experiments made upon dogs, and advocates the gradual closure of large arteries.

He used waxed cotton tape $\frac{1}{4}$ in. wide, which was passed round the aorta and through a gauze-covered silver tube, "both ends of the tape being fastened to the axle of a small windlass fixed to the instrument at its outer extremity. The revolving of this tightened or relaxed the tape at the will of the operator. The wheel could be fixed at any point by means of a hinged bar being pressed into small slots in the

¹ *Amer. Journ. of Med. Sci.*, September, 1900.

² *Ann. of Surg.*, 1902, xxxv, 207.

³ *Ibid.*, 1903, xxxviii, 256.

margin of the wheel. A circular perforated disk was attached to the arterial end of the silver tube and the perforations for the tape were so arranged that the margins of the tape did not press unduly on and injure the pulsating artery. The pressure was gradually increased and occlusion completed after about 40 hours. No unfavourable symptoms due to the closure were observed. Stratton claims that these experiments are sufficient to demonstrate the fact that at least in dogs a large artery can be gradually constricted without undue violence to its walls. Crile¹ had already proved that the carotid arteries could be gently occluded for 21-48 hours by clamp pressure without noticeable damage to the arterial wall and that when the clamp was removed after a number of hours the circulation was re-established. Crile based his conclusions upon 19 experiments on dogs and 18 operations on the human being. In no case did thrombosis or emboli occur.

Stratton believes that the gradual occlusion of the abdominal aorta above an aneurysm will be found very serviceable in the treatment of the latter. He maintains that the best results are obtained by the gradual formation of laminated clot within the sac and not by the sudden clotting of the contents *en masse*. Moreover the collateral circulation to the abdominal viscera and limbs will thus have time to develop and the serious symptoms that follow sudden complete occlusion of the aorta will be avoided. Further it is possible that by this method the circulation through the aorta at the base of the aneurysm to the main arteries below may not be abolished.²

Stratton relates a case of aneurysm of the abdominal aorta treated in the manner described above.³ The constrictor was applied above the sac and gradually tightened. The patient did well for two days but then sensory and motor paralysis of the lower limbs developed and death occurred.

The cause of death was the inhibition of the functions of the abdominal viscera which resulted from the ultimate complete closure of the aorta above the celiac axis. The sac was filled with stratified clot; there was no injury or necrosis of the aorta.

This method is certainly worthy of further trial.

(B) **Aneurysm of the Iliac Arteries** Proximal ligature is the best treatment for these and the transperitoneal is the safest route to adopt for this greatly reduces the risk of injuring the sac and also allows a thorough examination of the vessels above the aneurysm. The ligature can then be applied at any spot selected and without danger of including important structures like the ureter.

This operation however should not be lightly undertaken without the advantages of good assistance and modern conveniences such as the Trendelenburg position and good intestinal retractors (see pp. 866 and 867. Makins and Maynard's cases).

(C) **Aneurysm of the Hepatic Artery** Kehr⁴ records a successful case of ligature of the hepatic artery for an aneurysm of that artery which had simulated gall stones at first and later ruptured into the cystic duct causing hæmatemesis.

Haussons in 1897 collected twenty-two cases. In only three of these was surgical treatment attempted and all the patients died.

Ligation or excision may be tried in a similar case and also in the very rare cases of aneurysm of the splenic and mesenteric arteries.

(D) **Aneurysm of the Renal Artery** This has been discussed at p. 545.

¹ *Ibid.* 190 xxxv 441

² Morris *supra* cit.

³ *Journ. Amer. Med. Assoc.* March 10 1906

⁴ *Mich. Med. Week.* 1903 p. 1801

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